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COLLECTIVE REVIEW

BONE-GRAFTING

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As the result of long animal experimentation and experiments on human beings, the best and most successful method of transplanting bone seems generally agreed upon by almost everyone to be as follows:

The graft should be living, free or pedunculated, with as much periosteum covering as possible, and also containing endosteum and marrow, and the graft should be autogenous; that is, taken from the patient who is to be grafted. It seems certain that if a graft be made according to these rules nothing further is necessary to ensure success, save the attainment of asepsis and the maintenance of immobilization. So much for the practical application of what has been determined by long clinical experience to be the best method of grafting. When we come to the academic question of what the physiology of the various elements which go to make up this graft is, we enter upon ground which even to this day is a battlefield and which is as yet undecided. We have made a great gain in knowing how to make a successful graft. However, the practical has outstripped the theoretical, for we do not as yet positively know upon what the life of a graft depends nor where the new bone comes from.

We will first endeavor to classify the various views of authorities and then proceed to elaborate some of them.

1. There is either no or only slight osteogenetic power in the periosteum. (Gallie and Robertson, Murphy, Brown and Brown, Delbet, Davis and Hunnicutt, Macewen, Bancroft, Baschkirzew and Petrow, Wetherill, and Groves.)

2. Osteogenesis lies in the young connective tissue surrounding the transplant. (Baschkirzew, Barth [originally], and Bancroft.)

3. Osteogenesis lies chiefly in periosteum and to a much less extent in endosteum, marrow, and haversian canal linings. (De Gouvea, Axhausen, Lewis, Nicholls, Lexer, Ochsner, McWilliams, Schepelmann, Streissler, Albee, Stieda, Haas, Lobenhoffer, Ollier, Gill, Ryerson, and Codivilla, Tomita, Phemister, Barth [recently but not originally].)

4. Osteogenesis lies entirely in the osteoblasts within the bone of the graft itself, and its regeneration takes place independently of the periosteum. (Macewen and Groves.)

5. The graft is not osteogenetic in itself but it is simply osteoconductive of cells from the contacting extremities of other living bone. (Murphy, and Barth [originally].)

There are three distinguished names in the history of bone-grafting: Ollier, Barth, and Axhausen.

Ollier's conclusions, according to Axhausen, are:

1. Bony material of different origin and preparation can become operatively incorporated in the body without being extruded.

2. There is a fundamental difference in the relation of the healed in bone between living, periosteum-covered bone from the same species on the one side and any other bony material on the other.

3. Only the first shows increase in thickness after healing in by quick formation of inner fibrovascular connections, which result from the laying down of newly formed bony tissue by the periosteum, which remains living. The increase in thickness is the single sure sign

of the continuance of life. Only by such bone can there arise the possibility of a true inhealing with preservation of vitality.

4. Every other bony piece dies, even though it were not dead when transplanted. Such pieces remain either unchanged as foreign bodies while the surrounding tissues furnish a connective-tissue capsule, or they become absorbed, which process is often hastened by their becoming honeycombed with blood-vessels. Such bony pieces implanted into an osteogenetic layer, under certain favorable conditions, can become replaced by new formed bone tissue from the neighborhood.

5. In every instance where there is an endeavor to obtain lasting bony replacement for lost bone, one must in principle use exclusively living periosteum-covered bone from one of the same species.

These teachings of Ollier remained undisputed till Barth maintained, about the middle of the nineties of the last century, that any bone, whether living and periosteum covered or living without periosteum, whether boiled or macerated, took up the rôle of a dead foreign body, which could fulfill a certain mechanical end when surrounded by living tissue, but which was gradually replaced by new formed bone tissue whose origin in no way could spring from the periosteum or marrow of the implanted bone, but could come alone from the osteogenetic tissue of the surrounding parts; thus it was demonstrated that living grafts have no advantage over dead ones.

Thus stood transplantation until 1908, when Axhausen, as a result of thorough microscopical examination of a human graft and after numerous animal experiments, published the following conclusions:

1. The Barth statement of the histological indifference of any bony implantation material cannot be held as correct.

2. The fundamental difference maintained by Ollier between living periosteum-covered bone from one of the same species on the one hand, and all other bone material on the other, corresponds in its practical side to the facts. It applies both to the human as well as to the animal race.

3. This difference does not lie histologically in the relation of the bony tissue itself, as Ollier maintained. Contrary to Ollier, Barth's statement is correct when he says that in the transplantation of living, periosteum-covered bone from one of the same species, the bony tissue itself dies and is replaced by new formed living bone.

4. The difference lies alone in the presence of the living, periosteal covering.

5. The living, covering periosteum does not in all cases undergo necrosis, as Barth maintains, as is the case with the bone tissue itself; but the periosteum remains under favorable conditions in men, as in animals, at least partly living, and develops from these parts a bone-forming activity which increases in extent and remains permanently, replacing the old bone.

Barth has lately changed his opinions and now accepts the views of Axhausen that the compact bone of the graft is absorbed and is replaced by bone formed by the periosteum and endosteum of the graft.

Thus we see that Ollier thought that when autoplastic bone plus periosteum and endosteum was transplanted into a position where it had a function to perform, the entire transplant lived, while Barth claimed that the entire transplant died and was replaced by an ingrowth from the surrounding proliferating bone. Axhausen believes that the periosteum and endosteum alone remain alive while all the bone-cells except a few about the cortex undergo necrosis and absorption. The periosteum and endosteum proliferate and the cells thus formed help to form the union between the graft and the bone into which it is transplanted. These cells also grow into the haversian canals with revascularization, absorb the old bone and deposit new in its place.

Macewen, of Glasgow, in 1912, advanced the view that the bone in a graft is reproduced from the proliferation of osteoblasts derived from the osteoblasts within the bone of the graft itself, and its regeneration takes place independently of the periosteum, whose only function is that of a limiting membrane, which prevents the spread of the osteoblasts into the surrounding tissues.

Shortly after Macewen, in 1912, Murphy maintained that the graft was not osteogenetic but simply osteoconductive. Provided it be in contact at one or both extremities with other living bone, the graft acts simply as a scaffolding for the growth of the capillaries with their osteogenetic cells as they advance from the living, contacting extremities into the graft. The periosteum takes no part in the actual reproduction of new bone. This largely follows out Barth's original views.

The following are the conclusions of some of the authorities who do not believe in the osteogenetic power of the periosteum.

Gallie's conclusions, as a result of experiments made with grafts without periosteum, are as follows:

1. Death of the graft.
2. Revascularization of the graft.
3. Concomitant absorption of the dead bone and production of new bone by the bone-cells which invade the graft along the route of the new blood-vessels.
4. These experiments show no difference in the value of fresh or boiled bone as a transplant and no difference in the gross and histological changes incident upon the introduction of autogenous and heterogenous bone-grafts.

Bancroft's conclusions in a series of experiments in which two types of repair of bone have been observed, are as follows:

1 Where the periosteum has been well stripped off the bone for a distance of several centimeters it is separated

from it by serosanguinous fluid. Here the bone has apparently been repaired from the medullary cavity by a framework of connective tissue upon which calcium salts have been deposited, forming osteoid tissue; there has also been a reparative process from the connective tissue of the haversian canals at the sides of the bone incision.

2. Where the bone has been repaired under a definite fibrous connective-tissue capsule, which is continuous with periosteum and also adherent to the surrounding muscles, it has been found that this connective tissue is apparently not different from other connective tissue, except that in immediate approximation to the newly forming bone there is a single layer of cells which are larger in shape and have nuclei that take a heavy stain. In places, there is a metaplasia from the connective-tissue cells to these osteogenetic cells.

In the process of repair in fractures by the output of callus, there is a metaplasia from connective tissue which seems to arise from the surrounding tissues rather than to be a direct continuation of the periosteum. There is also a direct metaplasia from a tissue closely resembling fibrocartilage into young bone.

In attempting to draw clinical deductions from these experiments in regard to transplantation of bone, it is reasonable to assume that the periosteum acts as a limiting membrane to the bone, tends to conserve its shape, and to furnish its blood supply. If the periosteum is stripped from the bone of the transplanted part, numerous thrombi will occur where the vessels enter the diaphysis; but if the periosteum is left attached, the blood-supply will probably be more quickly established through the vessels of the periosteum.

If small pieces of bone are transplanted, it is obvious that haversian canals must be cut in many directions, thus allowing easy ingress to the newly forming blood-vessels. The fragments must also receive a good blood-supply from the entire periphery. They grow in this case without the aid of periosteum.

Davis and Hunnicutt's conclusions are as follows:

Free periosteal transplants did not produce bone in the large majority of experiments, even though osteoblasts were adherent to the transplants.

Pedunculated flaps of periosteum did not produce new bone.

Free periosteal transplants and pedunculated periosteal flaps, with bone shavings attached, produced bone in each experiment. From this we may surmise that bone particles had been accidentally transplanted in those experiments in which bone was found after the transplantation of free periosteum.

The removal of periosteum had little, if any, effect on the nutrition of a bone. The surface from which the periosteum was removed showed very little overgrowth of bone, unless there had been considerable irritation of that surface, either by trauma or by infection. The area from which the periosteum had been taken was covered with a thin, very adherent, fibrous membrane; or the muscle was adherent to the denuded area.

Both auto- and iso-bone, without periosteum, were effective in repairing skull defects.

Auto- and iso-bone, without periosteum, when transplanted into the periosteal tube after subperiosteal resection of a rib caused stimulation of bone-growth from the periosteum and also the rib ends.

Transplants covered with periosteum, and also foreign bodies, stimulated bone-growth only from the rib ends.

After subperiosteal resection of a portion of a bone, the growth of a bone in repairing the defect was from the bone-stumps, the periosteum acting as a limiting membrane.

Autobone, both with and without periosteum, lived and was successfully transplanted to fill defects in bone. Clinically, it is advisable to transplant bone covered, in part at least, with periosteum.

Isobone in a bone defect acted as a scaffold for the growth of new bone from the living bone-stumps, but there was ultimate absorption of the transplant.

Brown and Brown's conclusions are as follows:

1. We have been unable in any experiment to reproduce bone from free periosteal transplants into the subcutaneous tissue and muscle.

2. We have been unable to reproduce bone in the periosteal flap raised, left in contact with the bone, passed through muscle, and again contacted with periosteum, with the one single exception where there was a small nodule of bone formed apparently in the free end of the flap, corresponding to another nodule formed on the shaft of the bone opposite, leading us to believe that the bone in the tip of the free periosteal flap was an osteoblast raised from the corresponding area on the shaft of the bone and also because no bone had formed anywhere else in the flap.

3. We have been unable to reproduce bone in a single experiment from free bone transplants, without periosteum, into the subcutaneous tissue and muscle, regardless of the age of the transplant. Absorption was the rule in every case.

4. We have been unable to reproduce bone in a single experiment where bone was transplanted free, periosteum left intact, into the muscle or subcutaneous tissue. These transplants were uniformly absorbed.

5. We have been uniformly able to reproduce bone when transplanted and contacted with living bone, if it were in position where it had a function to perform, except in one experiment where the transplant was only 9 days old.

6. Other necessary conditions being present for its reproduction, bone reproduces bone without the aid of periosteum.

7. Our transplants that were contacted with living bone and had no function to perform were inclined to absorption.

8. While periosteum may be an aid to the life and growth of bone, we have not been able to prove in any experiment that it was at all essential.

Baschkirzew and Petrow believe osteogenesis lies in the connective tissue surrounding the transplant. In their communication from the St. Petersburg Medico-Military Academy, extensive animal experimentation is described and illustrations given of those cases in which a long bone-graft was implanted. The results confirm the possibility of successful transplantation, provided the implanted bone is living and is taken

from the subject or from another of the same species. Illustrations of one patient four years after the graft showed that an autoplastic shaft of bone from the fibula of the left leg, 9 cm. long, taken out of its periosteum, healed in place and functionated perfectly, taking the place of the right ulna which had been removed for a supposed sarcoma, although the lesion proved to be tuberculous. The illustrations show further the regeneration of the fibula from the periosteum which had been left in place, a stout although rather uneven new fibula resulting. A scrap of the grafted bone under the microscope showed many dead, but also numbers of living, bone-cells. Grafts and consecutive regeneration progress far more satisfactorily when autoplastic material is used. "There is no other conclusion possible to draw from this case than to accept the statement that the chief spring of the regeneration in a bone transplant into the soft parts lies in the young connective tissue which arises out of the original granulation layer about the transplant." He says the bone in a transplant gradually dies but exercises upon this connective tissue a specific irritation which leads to the formation of new bone. The old bone serves as a scaffolding and in this the process of the substitution takes place. Regeneration and bony new-growth taking place out of the cellular elements of the endosteum and periosteum cannot be denied. However, they are of less importance than the replacement out of the elements of the connective tissue.

For Bancroft's views see page 2.

3. The following authorities with their respective conclusions believe in the osteogenetic function of the periosteum (for further facts see page 19.)

Lexer says: "Even the greatest bony defects, such as an entire diaphysis or a portion of the skull, can be replaced with complete clinical success by bones of any kind or origin — whether living periosteal bone or dead bone, either auto- or homoplasty — even by foreign material such as ivory, metal, or horn, provided that the periosteum in the wound is entirely retained and remains united to the soft parts. If the question is of the replacement of a great bony defect, free of any periosteum, there will be success only in case the periosteum on the fresh bony transplant becomes quickly united to the vicinity, that is, if it can receive nourishing vessels from the vicinity rapidly. If the periosteum is prevented from quickly uniting to the neighboring structures by bloody or inflammatory effusions, it then dies and cannot exercise its function of renewing the bony substance. The rôle of the periosteum in bone transplantations consists, in the first place, in its close union with the surroundings which nourish it, and, secondly, in its activity in forming bone. The periosteum gets its nourishing vessels entirely from the immediately adjacent soft parts. The anastomosis through the cortex springing from the marrow, plays scarcely any rôle. The productive strength of periosteum, as well as of the endosteum and marrow, depends upon new formation of external blood-vessels." Lexer lays emphasis upon the vessel relations in the healing of fractures. He has demonstrated a very large amount of new vessel formation about a fracture spot until the fracture is healed, then the vessels disappear. These vessels arise from the periosteal network, not from the nutrient artery which is torn by the fracture. The lion's share in the quick healing of a fracture depends upon the nourishment brought by the periosteum through rich vessel new formation. Consequently, in operating on fractures, in laying the fracture ends bare, the periosteum under no conditions should be robbed of its union with the soft parts, and secondly, one should avoid injuring the periosteum.

McWilliams' views, based on his experiments and human transplantations, are as follows:

Were the blood-supply perfectly restored in the bone of a living graft, then it is evident that the graft would not die and would not become absorbed. But this is not the case as the physical properties of bone prevent absorption of blood sufficient to maintain the life of the bone until the vascular circulation is reëstablished, consequently, more or less of the bone dies. Undoubtedly many of the bone-cells on the surface survive while the deeper ones die. In any case it is a varying question as to how many of the cells actually survive. The inner layer of the periosteum, the endosteum and, to a much less, if not negligible, extent, the lining of the haversian canals provide the cells for osteogenesis in bone repair, to which may be added the comparatively few bone-cells in the graft itself which survive. Of these the periosteum is much the most important, probably doubling the combined powers of all the other elements. This relation McWilliams found to be as follows: every graft (26 in number) made by the author *with* periosteum lived, while of 38 grafts made *without* periosteum, but 21, or 33 per cent, survived. Of these grafts made *without* periosteum, the new bone must have come either from the endosteum or the lining of the haversian canals or the surviving cells of the graft itself, or all combined, leaving out of account the surrounding connective tissues. If this be true, then the relative importance of the periosteum, as compared with the combined powers of the endosteum, the lining of the haversian canals, and the surviving bone-cells, is as 100 to 55. The author has made four human transplantations *without* periosteum, all of which healed by primary union. In not one of these did the graft survive, all gradually becoming absorbed by molecular disintegration. In each of these transplants, without periosteum, there was endosteum

(three being made with entire sections from ribs and the fourth being taken from a section of the tibia with endosteum on it), together with bone-cells and the haversian canal linings. Consequently, from this we see that the periosteum is a very important structure in osteogenesis and bone-graft repair. Of the few reported successful bone transplantations made without periosteum, the influence of the endosteum has not received sufficient attention, although its power of osteogenesis is far inferior to that of the periosteum.

Oechsner's conclusions are as follows:

1. The autogenous transplantation of bone is an established surgical procedure.
2. Whether dependent for growth on periosteum or upon the graft as a scaffold for the development of blood-vessels, transplants should for the present be provided with both, particularly plenty of periosteum.
3. Non-absorbable material had better be avoided wherever possible; dovetailing and absorbable suture material should be used in their stead.
4. It is highly probable that organized bone tissue will in the future take the place of foreign material now used in the Lane plates for fractures.
5. For the present the thorough applicability of heterogeneous grafts has not been established.
6. Bone-grafting should never be done in the presence of an active infection.
7. Most rigid asepsis should be exercised.
8. Bone-grafts probably owe their virility and ultimate success to the rapidity of blood-vessel development plus the presence of osteoblasts wherever they may be.
9. Growth in the length of bone may be confidently predicted in the case of children when the epiphyses remain intact.

Albee's conclusions are as follows:

1. My experience as to the trustworthiness of the bone-graft, as a surgical agent, when taken with its enveloping membranes (periosteum and endosteum) and contacted with bone, has been borne out by Murphy, McWilliams and others, who have obtained practically 100 per cent of successes. In my last 100 cases the successes have been 100 per cent.
2. The endosteum, marrow substance, and periosteum should be included on the graft, as they play a most important rôle in aiding to establish an early and sufficient blood-supply from the recipient tissues to the cortical part of the graft. The endosteum, as well as the inner layer of the periosteum, is also actively osteogenetic.
3. A rapid and complete union between graft and recipient bone should be in many cases enhanced by the interposition of numerous small grafts in which the periosteum may be disregarded because of the easy access of blood-supply to their interior osteoblasts. These coalesce with each other and also with the recipient bones and the large graft.
4. The living bone-graft has certain bacteria-resisting properties, as evidenced by two of my animal experimental cases where sepsis occurred and parts of each graft became united to the recipient bones, while the rest of the transplant succumbed to the infection and sequestrated.
5. The bone-graft apparently acts always as a stimulus to osteogenesis to the bone into which it is ingrafted or contacted.
6. The bone-graft when well contacted becomes immediately adherent to the recipient bone by newly-formed tissue which changes to solid bone within four weeks' time. This together with its bacteria-resisting property strongly favors, in the author's opinion, the substitution, when feasible, of the bone-graft in place of all metal internal splints, especially when it is appreciated that metal has the opposite effect to the graft, in that it inhibits callus formation, produces bone absorption, and favors infection.
7. The dowel, the inlay, and wedge bone-graft afford a means of repairing and remodeling the skeleton which the surgeon has not hitherto possessed.

Phemister has written an exceedingly valuable report on his experiments in bone transplantations. His conclusions are as follows:

1. Osteogenesis in bone repair occurs from the inner layer of the periosteum, from the endosteum, and to a much less extent from bone-cells and fibrous contents of the haversian canals.
2. Viability of the cells of the transplant is dependent largely upon their ability to get nutrition and to some extent upon their degree of cell specialization. Periosteum and endosteum, being superficially located, receive sufficient nutrition to survive and proliferate. The great mass of bone-cells being away from the surface and surrounded by an extensive and difficultly permeable calcified matrix gradually undergoes necrosis and absorption. A few about the periphery and lining the larger vascular spaces, as well as the fibrous elements of the latter, may survive and proliferate. Blood-forming cells of the marrow, despite their favorable nutrition and probably because of their greater degree of specialization, gradually undergo necrosis.
3. The subsequent changes which the transplant undergoes depend upon its composition and location. According to Roux's law of functional adaption, a transplant placed in a useful location, i.e., a bony defect, undergoes progressive changes, while one in a useless location, i.e., soft parts, undergoes chiefly retrogressive changes and is gradually removed.

A. Transplantation into a bony defect.

Functional demand stimulates the surviving cells of the transplant to osteogenesis. Callus forms at either end which helps to unite the transplant and the fragments. Creeping substitution of the dead cortex gradually occurs by the ingrowth of capillaries with dilatation of the haversian and Volkmann canals, absorption of the old bone and deposition of new bone in its place.

(1) When periosteum and endosteum are left on, the transplant contains the greatest number of living osteogenetic cells. Consequently union between the ends and substitution of the dead cortex occurs most constantly and rapidly.

(2) When periosteum is removed, osteogenesis producing union and substitution occurs from the endosteum and the few surviving cells of the cortex, but the process is much slower than when periosteum is left on.

(3) When both periosteum and endosteum are removed, new bone formation from the few surviving cells is slight, and union with the ends of the fragments and substitution of the dead bone are very much delayed.

If such a transplant is cut into small pieces before implantation, more cells survive because of the increase in surface and facilities for nutrition and greater functional irritation. Consequently, considerable callus forms from each piece, and, fusing with that from the others and from the ends of the shaft, rapidly restores the continuity of the shaft. Ossification of the callus proceeds from the surface of each piece, and substitution of their dead portions gradually occurs.

Axhausen's claim that osteogenesis does not occur from

transplanted bone devoid of periosteum and endosteum is incorrect. Equally erroneous is the old view of Barth, now advocated by Murphy, that there is no osteogenesis from any portion of a transplant, substitution occurring entirely by an ingrowth of the fragment ends.

(4) Periosteum transplanted into ulnar defects and subperiosteal ulnar resections failed to regenerate bone and restore the shaft, but in subperiosteal resections with reimplantation of cortex, either alive or after being boiled, it formed a layer of callus about the reimplanted portion. Subperiosteal resection of the humeral shaft in the young was followed by regeneration of the shaft.

Periosteum gets its chief impulse for osteogenesis, not from an injury to itself, but from the injured bone to which it is attached or intimately related to and which demands repair.

B. Transplantation into soft parts.

The same portions survive as in a bony defect, but since there is no functional demand for bone in this location little proliferation or substitution occurs and the transplant is gradually absorbed.

Transplanted periosteum produces little or no new bone for the same reason.

4. The presence of an infection, if severe, results in death and failure of the transplant; if mild, there is set up in it an osteomyelitis with excessive proliferation and absorptive changes, but the transplant takes and is functionally a success.

5. A fracture through a transplant unites by callus formed from the surviving cells of the transplant in the vicinity of the fracture.

Lewis concludes as follows:

1. Experimental and clinical work demonstrates that the compact bone-graft is gradually absorbed, that it is replaced by new bone formed from the periosteum and endosteum of the graft. The periosteum of the bone into which the graft is inserted plays an important rôle, and should be saved and brought in contact with the periosteum of the transplant or over the ends of the same. This is now admitted by Barth, who first stated that a bone-graft had merely an osteoconductive function.

2. The viability of bone-grafts is especially indicated by their reaction to infection, for involucrum and sequestrum formation occurs in infected grafts or in those placed in infected areas as it does in normal bone.

3. Bone-grafts placed in cavities, resulting from curettage of central giant-celled sarcoma or fibrous osteitis, will not survive in most cases, for the hæmatoma which occurs within the cavity prevents vascularization of the graft. The cavities can be closed most satisfactorily by a bone-plug of some kind.

4. The inlay graft in the treatment of old ununited or recent fractures is more satisfactory than the intramedullary splint, for the endosteum of the graft comes in contact with endosteum of the bone, and periosteum of the bone can be sutured to the periosteum of the graft. In the intramedullary splint, considerable endosteum is destroyed in preparing the medullary cavity for reception of the graft, and the endosteum is one of the important factors in bone repair.

5. Compact bone dies in the graft because of its physical properties which do not permit of rapid permeation of serum. The best bone-graft contains enough compact bone to give form and maintain fixation and also contains periosteum and endosteum from which the compact bone is substituted. Grafts taken from the anteromedial surface of the tibia are to be preferred to those taken from the crest.

Gill's conclusions are as follows:

1. Bone is only a particular form of connective tissue and is readily transplantable.

2. It contains within itself all the elements necessary to its life, function, and regeneration provided it receives sufficient nourishment.

3. Periosteum, medulla, and bony tissue should all be included in the graft.

4. After transplantation the bone grows and moulds itself to perform its function efficiently.

5. As early performance of function as is consistent with its fixation in its new position is of great advantage.

6. A mild infection is not necessarily fatal to the graft.

7. Transplantation of long bones with their joint surfaces is clinically possible. The inclusion of cartilage and joint surfaces in no way adds to the difficulty of the transplantation.

8. Half joints are clinically transplantable. Lexer, Küttner, Rovsing, Wolff, Enderlen, Perthes, von Haberer, Walther, and De Gouvea have reported successful cases.

9. Whole joints have been successfully transplanted. Lexer has had under observation for six years a knee-joint in which motion and function are perfectly free and satisfactory, although the joint shows under the X-ray certain changes similar to those found in arthritis deformans.

Haas gives the following conclusions as the result of his experiment:

1. The periosteum is directly and actively concerned in the regeneration of bone. In the very early stages the periosteum proliferates to form a cartilaginous tissue, which is later transformed into bone.

2. The exact method of the changes from cartilage to bone cannot be determined. There is considerable evidence in favor of the direct change of the cartilage-cell into the bone-cell. There is at times the appearance of the osteoblast forming bone and subtituting the cartilage; therefore it seems as though both processes can take place at the same time.

5. The regeneration of bone also takes place from the marrow and cortical bone, but in a more limited degree and at a later period than that from the periosteum.

4. The regeneration of cartilage takes place almost entirely from the perichondrium. It proceeds by a direct proliferation of all the layers of the perichondrium beneath the outer fibrous tissue. There is some evidence in favor of the view that the connective tissue is also transformed into cartilage under stimulation of the neighboring cartilage or perichondrium.

5. There is a slight amount of regeneration of cartilage from the original cartilage near the perichondrium, but the remainder of the cut ends tends to undergo degenerative changes.

6. The extent of the removed cartilage exerts no influence on the regeneration. (There is no evidence of calcareous changes in the regenerated cartilage, even as late as 46 days.)

Osteogenesis lies chiefly in the osteoblasts within the bone of the graft itself and its regeneration takes place independently of the periosteum. Macewen's views have already been given and those of Groves follow. Groves,[1] gives "An Experimental Study of the Operative Treatment

[1] Brit. J. Surg., 1913, i, 499.

of Fractures." A few of his many conclusions are as follows:

17. In the repair of bone defects:

A. Natural repair occurs rapidly when only part of the bone is destroyed.

B. Fragments of bone used as a graft (from the same animal) form new bone very slowly if they are only loosely inserted in the gap.

C. Large pieces of bone used in a graft unite quickly and form the center of new bone-growth, if they are tightly fixed to the raw surfaces of vascular bone.

18. The periosteum is the *product* and not the *mother* of bone. All the osteogenetic properties of the periosteum, whether in the repair of fractures or in grafting, are due to the more or less accidental presence of the outer layer of bone-cells adherent to its deep surface.

19. Living bone is the chief source and origin of callus which grows mainly from the outer or periosteal surface and to a less extent from its deep or medullary surface and its cut ends.

CONCLUSIONS

The works, as we have seen, in the last few years upon the subject of bone transplantations are appallingly numerous, both from the experimental and clinical aspects, and they are as yet far from solving the question of whether one can secure a bone-graft with survival of the transplant or whether one obtains only a gradual substitution of the graft by the tissues of the neighboring old bone. But practically and therapeutically very numerous observations have established the great use of the bone transplant. Physiologically, the anatomical evolution of the graft must yet be established, but lack of knowledge of this does not practically prevent the surgeon from obtaining great success with grafts transplanted according to the rules shown to be most successful in the greatest number of transplantations.

INDICATIONS FOR BONE-GRAFTING[1]

1. To correct deformities resulting from defects of development, as aplastic extremital bones — radius, ulna, humerus, tibia, fibula, and femur — and congenital and acquired saddle-nose, aplastic mandible, spina bifida, etc.

2. To produce union in ununited fractures. This is the best treatment and much superior to Lane's plates.

3. To replace bone removed by destructive infections, osteomyelitis, tuberculosis, lues, etc., e.g., spina ventosa.

4. To restore or supplant fragments dislodged or destroyed by fractures, as the head of the humerus, head of femur, shaft of tibia, etc

5. To replace bone removed for non-malignant neoplasms, cysts, myeloma, osteitis fibrosa, and adamantinoma of the jaw.

6. To replace bone removed for encapsulated malignant disease, as giant-celled and chondrosarcoma, etc.

7. To immobilize joints, as, for example, those with too great laxness or imperfect muscular control, resulting from infantile paralysis or Charcot's joint, and for the cure of tuberculosis of joints, as in bone-grafting for tuberculous spine (Albee's operation).

METHODS OF BONE TRANSPLANTATION

For the sake of completeness the entire range of transplantations which have been done are now given in the following table:

METHODS OF BONE TRANSPLANTATION

1. Heteroplasty:
   - *a*. Foreign substances such as ivory, silver, magnesium, horn, etc.
   - *b*. Animal bone:
     1. Living.
     2. Dead.
     3. Decalcified bone.
2. Homoplasty:
   - *a*. Living bone preferably taken with periosteum either from a cadaver immediately after death or from a fresh amputation.
   - *b*. Dead bone either boiled or sterilized in antiseptics.
   - *c*. Transplantation of joints from fresh cadavers, resections, or amputations.
3. Autoplasty:
   - *a*. With pedunculated bone-flaps, necessarily with periosteum.
     1. With temporary pedicle, e.g., Reichel's operation on tibia.
     2. With permanent pedicle with either cutaneous or musculocutaneous or periosteal flaps.
        - (*a*) Ollier's operation *par renversement*.
        - (*b*) Ollier's operation *par glissement*.
        - (*c*) Ollier's operation *par implantation*.
        - (*d*) Müller's two operations.
        - (*e*) Hahn's or Huntington's operation.
   - *b*. With non-pedunculated bone, i.e., free grafts.
     1. Transplantation with small chips with or without periosteum.
     2. Transplantation with large fragments always covered with as much periosteum as possible.
     3. Transplantation of a part of the shaft of a bone plus one of the articular ends.
     4. Transplantation of joints.
   - *c*. With pedunculated or non-pedunculated periosteal flaps (Codivilla's operation).

[1] Modified from Murphy. J. Am. M. Ass., 1912, lviii.

It shows the historical development of what has been proved to be the best clinical method of performing a successful transplantation; viz., to transplant a free, living graft, with as much periosteum on it as possible, taken from the patient who is to be grafted. There may be some rare instances where some other one of the homo- or autoplastic procedures, to be later mentioned, may be advisable, but these are rare. A pedicle has been proved to be not at all necessary. It simply complicates what is ordinarily a much simpler method. There are instances, however, where it is necessary to supply not only bone but also soft parts, in which a pedicle will be the best method, such instances are the supplying of soft parts as well as bone to make up the loss of the entire nose or to supply not only portions of the lower jaw but also the soft parts over this which may be lost, e.g., shot away or resected for cancer, etc. In case a homoplastic transplantation is deemed advisable the bone should be taken from a very near relative, e.g., from father to child in a case of spina bifida. Heteroplastic transplantations have been proved to be very unsatisfactory and have been practically given up.

GENERAL PRINCIPLES TO BE OBSERVED IN BONE TRANSPLANTATIONS

1. Most scrupulous asepsis is an absolute essential to perfect success. It is most important that no infection be introduced into a clean field at the time the graft is transplanted. To this end the operator, assistants, and nurses should all wear rubber gloves, and the same scrupulous Lane technique should be employed as in fracture operations. Nothing that has been touched by the hand should go into the wound or touch the graft and all instruments and gauze wipes should be handled by instruments. It is advisable not to tie vessels but to allow the artery forceps to remain hanging *in situ* during the operation, after which they can be removed with little danger of bleeding. All sutures should be tied by means of clamps to avoid touching the sutures with the hands. Instruments once used should be laid aside and reboiled before using again. Sterile towels should be clamped all about the edges of the wounds so as to exclude the skin from the operative field. All this applies both to the site of the graft as well as to the field from which the graft is removed. A new knife should be used after the skin is incised and the old one should be laid aside. Tincture of iodine should be applied to the cut skin edges immediately after incision.

2. In general it may be said that all sinuses should be perfectly healed for at least three or four weeks before grafting is attempted so as to prevent infection of the graft. While infection does not necessarily mean the death of the whole graft, yet the danger that it may entirely die is great. Lewis has demonstrated in two cases that a transplant may be inserted into an infected area with the object of affording merely a mechanical support to prevent deformity, even if it is necessary to remove it later. In some instances such grafts may remain viable and hasten convalescence. (See under the effects of infection on grafts.)

3. The graft should be taken living from the same individual who is to receive the graft, i.e., an autoplastic graft, if the best and surest means for success are followed. If this be not possible, which is very rare, then it should be taken from as near a blood relative as possible. Animal bone should never be used because such a graft will be absorbed owing to the changed serological and chemical relations. If taken from another individual, syphilis should be ruled out by the Wassermann reaction and tuberculosis excluded.

4. A living graft should be transplanted *always* with as much periosteum covering it as possible. *Without* the periosteum the life of a graft has proved to be uncertain. Its retention will assure success if asepsis be attained. The question of just what the function of the periosteum is is an academic one. Practically the periosteum seems necessary for success in the greatest number of cases. Less important for success but still advantageous is to have endosteum also on the graft, for the whole of a thing is greater than any of its parts. The value of marrow seems to be small; according to some authorities it is disadvantageous.

5. The success of a graft seems to depend upon a speedy adherence of the periosteum to the surrounding parts that the blood supply may be as quickly established as possible. Effused blood will prevent this adhesion, hence bleeding and oozing should be checked to the greatest extent possible. In addition a blood-clot about a transplant does not permit of the permeation of serum into the bone and also prevents vascularization. Lewis gives several instances in which hæmatomata caused absorption of the grafts. On account of the oozing subsequent to the loosening of a tourniquet, this had best not be employed.

6. No drain should be used since this predisposes to infection.

7. A motor saw is of inestimable value in bone-grafting operations.

8. In taking a graft from the tibia, its crest should not be employed, for this is the strongest part of the bone and its removal will predispose to subsequent fracture. Before this was appreciated, McWilliams had two fractures of the tibia from whose crests grafts were taken, while other fractures have been reported. If the crest is used, the limb should be strengthened by a plaster splint for several months after the transplantation, as new bone in such a defect is but slowly re-formed.

9. All foreign non-absorbable material, wires, nails, celluloid, horn, rubber, etc., should be avoided as implants, except under very exceptional conditions. Encircling wires will erode the bone and a fracture may result. These non-absorbable foreign bodies tend to irritate, if not invite, suppuration and often produce sinuses which will usually require their removal. Chromic gut or kangaroo tendon should be used to fix the grafts in position.

10. When the head of the humerus, or radius, or femur is fractured and dislocated and the joint is opened, then the head should be replaced and attached to the freshened lower fractured surface, even though the head be dead, provided it is still aseptic (Murphy).

11. A graft increases in size according to the demands put upon it by the organism. Experience has taught that it is unnecessary to laterally fill up a defect completely with a graft. It is essential only to fill up a defect vertically, leaving Nature to do the remainder.

12. After transplantation absolute immobilization is essential for success. This should be maintained for at least three or four months, longer if röntgenograms show its necessity.

13. The periosteum of the bone into which the graft is inserted is an important element and should be preserved and brought into contact with the periosteum of the graft or over the ends of the same if possible.

14. The inlay graft in the treatment of fractures is to be preferred theoretically to the intramedullary splint, since endosteum comes in contact with endosteum while the periosteum of the graft can be sutured to the periosteum of the bone. A much more successful method of treating non-union in fractures than a Lane plate is the bone-graft. The intramedullary splinting has, however, given good results in the hands of many surgeons, particularly Murphy.

15. Transplantation of long bones with their joint surfaces has been successfully performed, as has been the case with half joints and with whole joints in a few instances.

16. A suggestion by Huntington seems valuable. He has found that the periosteum of a graft may be preserved *in situ* during operation, by wrapping the fragment closely with zero catgut. Before closing the wound, the strands of gut are divided and removed or cut short.

17. In operating on clean, comminuted fractures, the fragments should be replaced in their original positions if possible. If this be not possible, the pieces should be fragmented, retaining all the periosteum possible on the fragments, and replaced about the fracture spot.

18. The site from which a free graft may be obtained seems to depend upon the individual preference of the surgeon. The majority seem to have used the tibia, while the fibula has been preferred by others. In a few instances grafts have been taken from ribs, clavicle, scapula, and the crest of the ilium.

HETEROPLASTIC GRAFTS

Heteroplastic grafts are those made up of either foreign or alien grafts such as ivory, horn, rubber, silver, magnesium, etc., and animal bone both living and dead. They are either absorbable or unabsorbable.

Little space need be taken up with a discussion as to the advisability of using these grafts. They are more than doubtful in their results and the method has been generally abandoned. To understand, however, the development of the present successful methods of grafting it will be necessary to consider heteroplastic grafts for a moment, for it was almost the first method employed. The more than doubtful results obtained led to further researches to find a successful method.

1. *Foreign substances.* Since aseptic operations have become so successful, it is possible to have large foreign bodies heal in the body tissues without irritation. A good example is the Lane steel-plate. Unabsorbable material as such may remain *in situ* but it can never form a firm substantial adhesion of itself. It is encapsuled in connective tissue and this later can only become occasionally ossified in case osteogenetic tissue is present in the vicinity, as Pean's case shows. In the situation where there is no osteogenetic power present, where, instead of callus formation, resorption processes of the fragment have the upper hand, absorbable material will be absorbed without bone production, and the defect will be closed by connective tissue merely. Where the foreign substance is in an osteogenetic bed, it may become encapsulated in a bed of new bone. On the irritating properties of the foreign material

will depend how much secretion is produced. If this be large a sinus will form and the foreign material will be extruded, or it must be removed before the sinus will heal. Such foreign material may serve a useful purpose in affording support until the periosteum of the vicinity shall form new bone. The present tendency in surgery is to avoid, as much as possible, implanting any unabsorbable material whatsoever. Animal grafts, both living and dead, with or without periosteum, show almost no ability to produce new bone themselves and they have little stimulating effect upon the old bone to produce callus. At best they act but as a support until the old bone may perchance produce some new bone. This new bone is usually small in amount and insufficient.

Instances of the implantation of foreign material are as follows: Kronacher reported the case of a five-year-old boy, three-fourths of whose fibula he had resected for sarcoma. Five days later he implanted a 15-cm.-long solid ivory prothesis between the remaining bone ends. About three months later amputation had to be performed because of recurrence. The specimen showed that the invaginated ivory implant was surrounded at the upper diaphyseal end by a bone layer 4 to 5 mm. thick and on all sides was enclosed by a periosteal like, 1-mm. strong membrane and was enclosed at the malleolus by a walnut-sized cartilaginous like layer.

Prevost had resected the tibia for a tuberculous focus and filled the defect with small decalcified bone pieces. Smooth healing resulted, and, later, a röntgenogram showed no difference between the new and old bone.

Pean resected subperiosteally the upper half of the humerus and in the defect he placed a complicated prothesis made from platinum and rubber which was fashioned after a joint and was movable. The patient wore this prothesis for two and one half years when a fistula occurred. At this time it was shown that the periosteum had produced new bone. The prothesis was removed and the fistula healed.

Brendt implanted in a case of one-sided resection of the lower jaw a prothesis of celluloid. This prothesis was worn without reaction for four and one half years. The mouth can comfortably be opened and closed. He says in conclusion, "that such a large foreign body, a celluloid ring corresponding in size to the half of the lower jaw, healed in without fistula formation is remarkable."

Glück in 1890 implanted in a case of resection for osteosarcoma of the lower epiphysis and the condyles of the humerus, a 15-cm.-long ivory cylinder which was implanted into the medullary cavity of the humerus. He removed it later but accomplished through its stimulating influence a good functional end-result. He has published reports of a number of ivory implantations and his operations rely upon the healing in of foreign bodies which possess the only purpose of stimulating new bone from the vicinity. Wachsner in 1913 reported the results of a large number of ivory implantations according to Glück's method, with success in many cases.

Kausch reports the implantation of a metal foreign body in a resection defect in the humerus. The foreign body was removed after four and one half months because of continuous fever.

König implanted in a gymnast a 15-cm.-long ivory bone into the upper humerus. It healed in aseptically but the result was ruined because exarticulation had to be performed because of a recurrence.

Mysch attained good results in three cases in which he transplanted cow's horn.

König reports a case in which the trochlea and a hand's-breadth of the humerus above it were removed in such a manner that the external condyle and a humerus span just above it remained. He implanted into it a modeled ivory prothesis which healed in perfectly. The result after a year was painless; there was movement to more than a right angle and the joint was not flail in the least.

König gives his conclusions as to the implantation of ivory, with the results of eight cases after two years. He is enthusiastic as to its use.

Greifenhagen has used the method of Lexer, of bone-doweling by means of animal horn, ten times. He says the functional and anatomical results were very good.

Duvergey removed almost the entire tibial diaphysis for osteomyelitis. The defect was filled in by a correspondingly long piece of decalcified bone. There was profuse suppuration with sequestration of small bone pieces. The bone healed after 8 months with very good results.

A combination of heteroplasty and homoplasty was used in the following case. The transplants were grafted into a granulating field. Poncet in 1886 resected, in a boy of 15, almost the entire diaphysis of the tibia for osteomyelitis, leaving *in situ* the superior articular surface. A month after this operation, there being no fever and the granulation tissue being of good appearance, he transplanted into the defect bone fragments from a tibia and a fibula taken from a newborn babe, one hour after birth, who died of asphyxia.

They measured 8 mm. in length and 4 mm. in thickness. They were placed in the midst of the proud-flesh which more or less surrounded them. These bone fragments united for the most part. Fifteen days after this operation, he transplanted at the same time bone fragments coming from the tibia and the fibula of a kid which was killed for the purpose. United to their bone fragments, covered with their periosteum, they formed a bony column 8 cm. in height and about 5 mm. in thickness. Cicatrization was complete in two months. In six months one could demonstrate a newly formed tibia. Poncet reports the condition of the case after twenty-five years. The lower limb is 9 cm. shorter than the opposite extremity but the foot is at a right angle. The tibia is solid and has the same dimensions as the opposite one. The patient wears a sole in his boot and there is not the slightest sign of fatigue on walking. The repaired leg is as good as the opposite one. Röntgenograms show no trace of the old bone-grafts. Poncet says that the grafts probably did not grow, possibly they were absorbed after a greater or less length of time but they served a very useful purpose in stimulating osteogenesis in the neighboring tissues.

2. *Animal grafts.* In 1891 Kümmell reported a good result with interoplastic material. He transplanted into an ulna defect a piece from a decalcified ox's tibia. The limb was consolidated in four to five weeks.

McGill in 1889 in a pseudarthrosis of the right radius, the defect being three-fourths of an inch, inserted 13 pieces taken from a freshly killed rabbit's femur. This was followed by prompt consolidation without suppuration.

Patterson in 1878 reported a case of non-union of both bones of the forearm with a defect of three-fourths of an inch in the radius. A piece of a dog's humerus with periosteum was transplanted, the redundant periosteum being brought over the periosteum of the radius where it was sewed. The graft was held in place by silver wires. Two months afterward the wires had to be removed. The small wound remained open for twelve months when the dog's bone, reduced to half its size, came away, after which the wound healed completely. The forearm became very useful. No very definite statement is made as to consolidation.

Tomita reports a bullet wound of the front of the right humerus, accompanied by profuse suppuration. When healed a thigh bone 7 cm. long from a fresh living rabbit was transplanted, both ends being fixed to the freshened fracture ends by silver wires, resulting in primary union. Twenty-three weeks after the operation the lower fragment end was fast consolidated with large callus formation while the upper fragment had still some movability, although the X-ray showed a large amount of callus which had grown around the implant so that it almost touched the lower callus.

He reports a second case of a bullet wound of the middle of the tibia, accompanied by suppuration and sequestration. The defect which was 12 cm. long finally healed. A piece of thigh bone with periosteum and marrow from a freshly slaughtered calf was inserted, the most careful asepsis being observed. The ends of the transplant were inserted into the medullary cavities of the fragments. Drainage. Primary union. There were no sinuses at any time. Twenty-seven weeks after the operation the patient could walk without crutches and was discharged. The result was excellent.

Farquhar Curtiss reported three cases in which he filled bone cavities with pieces of decalcified bone, with successful results in all.

Moty, in 1895, reported a case of tibial pseudarthrosis in which a living graft from a sheep's tibia was implanted. There was expulsion of sequestra from time to time, but no consolidation. He also reports a second case of pseudarthrosis of the femur, into which he implanted a living graft from a sheep's tibia. There was no consolidation despite removal of the graft and a second freshening and suture.

Küttner in 1913 reported the case of a child into whose congenital fibula defect he grafted the shin-bone of a Java monkey. As a year and a half has elapsed since the operation a judgment as to the result is now possible. The röntgenogram shows that the monkey's bone is perfectly healed in the tissues, since there is no trace of any absorption and the epiphyseal line is still clearly to be made out. He says "that possibly the transplantation from monkeys is justifiable since the specific blood reactions between men and monkeys show a broad relationship." Küttner has also made a knee-joint transplantation from a monkey to a man with good result.

Allison in 1910 reported the case of a girl of 6, who from lack of development of the left inferior maxilla presented great deformity. The maxilla represented a toothless periosteal band which proved to be well-developed membrane. He implanted beneath this membrane a segment of bone taken from a recently killed chicken. The chicken's femur was split and brought into the required shape by a file before its implantation.

The periosteum was sutured over the graft with catgut. Primary union resulted. Three months later at a second operation the original graft was found to occupy the position in which it had been placed, and its size was undiminished. A second graft was placed in position a little higher and somewhat anterior to the first, which added to the cosmetic effect by lifting up the preceding tissues at the angle of the mouth. There was uncomplicated wound healing and the deformity was practically overcome.

HOMOPLASTY

Homoplastic bone transplantation is the grafting of bone from one individual into another individual of the same species. The graft has been transplanted either living or dead. Dead human bone, just as animal bone and foreign material, plays the rôle of an internal prothesis rather than that of a true graft. It simply furnishes a conductor, a matrix for the periosteal regeneration of bone coming from the neighboring, living old bone. How much exciting or stimulating influence dead bone will have on this formation of new bone is questionable. The graft can certainly furnish no new bone itself. This form of dead bone transplantation has been discontinued for good reasons. Homoplastic bone-grafts are far inferior in results to autoplastic bone-grafts; but the grafts should be taken *living* from another individual and always *with* periosteum. In transplanting joints, it will be necessary to make a homoplastic transplantation. To obtain a living graft, it will be consequently necessary to obtain it from a fresh amputation or from a cadaver soon after death.

The success of such a graft will depend on the serological relations between the individual from whom the graft is taken and the individual into whom the graft is to be transplanted. For in the one case the bone is originally laid down in serum of a certain composition, and bone from this individual may be transplanted into an individual whose serum may be of a somewhat different composition, hence the graft will be foredoomed to more or less chemical change. The chance for success of such a graft in homoplasty will be just about in the same proportion as the success attained in attempting to find two bloods in blood transfusion which will agree and not hæmolize when mixed. This is advanced as a more or less theoretical suggestion. Certainly bones from different individuals probably have different chemical compositions and the chance of grafting from one individual into another, bone of exactly the same composition would theoretically appear to be doubtful, resulting in cytolysis. In addition, the danger of sepsis and transmitting disease, as well as the inconvenience of waiting for a corpse or an amputation from an assured healthy individual, has caused this method to be almost given up. Homoplastic transplants have been occasionally successful, but not as many of the osteogenetic cells remain alive and actively proliferate as in autoplastic grafts; hence the formation of new bone is slower, and its extent is less, consequently it is more uncertain as to its ultimate success.

LIVING HOMOPLASTIC BONE TRANSPLANTATIONS

Küttner resected the upper third of a tibia for malignant chondroma in a man of 45. The resected bone was replaced by a fragment of a tibia taken from a cadaver 27 hours after death. This graft was very well tolerated. The patient has a movable knee and can walk.

A successful case combining a heteroplastic transplantation of a kid's bone with a homoplastic graft from an asphyxiated newborn fœtus is given by Poncet.

Lexer replaced the upper humerus end including the joint surface by a piece of a freshly amputated femur, with good result.

Fraugenheim reports four cases of doweling with homoplastic material.

Von Haberer resected two-thirds of the upper arm and filled the defect with a periosteum-covered fibula freshly obtained from an amputation. Primary union resulted and in five months the arm was fully functionated.

Baum implanted into four cases of pseudarthrosis, twice bones of freshly amputated extremities, and twice fœtal bones. All four cases gave negative results.

Anschutz achieved a relatively good result in a 7 cm.-long congenital tibial defect, which had been autoplastically grafted several times with no success, by transplanting bone from a perforated fœtus. A second smaller attempt with the bone of a seven-months' fœtus was unsuccessful.

Ollier replaced the totally necrosed ulna by a bony piece obtained in a fracture operation. After five months the transplant was absorbed.

Poncet filled the defect in a pseudarthrosis of the tibia by half the first phalanx of an amputated great toe. No consolidation resulted. He then transplanted bony pieces taken from a child asphyxiated at birth. These were extruded.

Samter in an osteomyelitic total defect of the tibial diaphysis transplanted a pedunculated periosteal bony flap which led to very small new

bony formation. He then implanted a 14-cm.-long cadaver bone, which after some time was also removed. Final consolidation resulted.

Barth reports the implantation into a tibial defect of a piece of bone without periosteum taken from a freshly amputated leg. Resorption without consolidation resulted. He also reports a case of ununited fracture of the left leg. A graft of a piece of bone without periosteum was taken from a fresh amputation. Absorption of the graft without consolidation resulted.

Grosse of Halle reported a case of pseudarthrosis of the tibia, in which implantation of a fragment from a fresh amputation in an adult resulted in consolidation in a year between the fragments and the graft. Radiographically demonstrated, the graft appears to have undergone complete reorganization and the child can walk well. This case was reported 12 years after the transplantation by Shelda, who says that the graft now cannot be differentiated from the old bone. The child limps because of the shortness of the limb due to the destruction of the epiphyseal cartilage.

Robertson resected the lower ends of radius and ulna for sarcoma, followed by implantation of radius and ulna with periosteum from a freshly amputated arm, the radius being wired. Amputation was necessary twelve months later because of recurrent tumor. Examination showed obliteration of the wrist-joint by fibrous tissue, also that the grafts were living. There was some motion between the fragments.

Morrison reports removing the diaphysis of a tibia for osteomyelitis and transplanting a portion of a fibula taken from a fresh amputation. Six years later the leg had to be amputated on account of deformity and failure to grow. The foreign fibula was not more than a third as large as it was when the operation was done.

Küttner transplanted into the defect caused by the resection of the superior extremity of the femur for sarcoma, an equal upper extremity of a femur removed from a cadaver three hours after death. This fragment was well tolerated. There were two local recurrences which were operated upon with success. Later, at the end of seven months, the patient suffered a spontaneous fracture at the point of union of the dead bone with the old bone. This fracture consolidated, and the patient had very satisfactory use of his limb. Küttner attaches great importance to this consolidation of the fracture and he thinks "that it shows better than any other proof could, that the bony graft had been truly alive."

Stuckey reports a case of pseudarthrosis in the middle third of the tibia. An osteoperiosteal skin-flap with base external was taken from the upper fragment. The fragments were freshened and the marrow removed. A dowel composed of a portion of the entire thickness of a fibula without periosteum was taken from an amputated leg. The marrow canal of the dowel, which was 11 cm. long, was filled with an iodoform plug, and was placed in the medullary cavities of the fragments and over this the osteoperiosteal flap was fixed with the same periosteal silk sutures. Complete consolidation resulted in 90 days. Nine months after the operation the patient fell and fractured the graft which soon healed. A curved deformity resulted which had to be remedied by osteotomy. Was not this new bone formed from the old periosteum?

Ternier resected the inferior half of a radius for sarcoma. He implanted into the defect a sufficient extent of the fibula taken from an amputation made a few minutes before. Primary union resulted. For nine months he followed the gradual incessant destruction of the graft which by "lacunar corrosion and decalcification" produced a gradual and complete disappearance of the graft. Ternier concludes that the pretended osteogenetic property of the graft does not exist, and that cytolysis and progressive absorption are almost the rule for transplanted foreign tissues.

Rovsing resected the lower part of the femur for sarcoma by a section from an old humerus, sterilized with care. The result was bad because the graft broke and there was no consolidation. He waited until he amputated a leg and took a section from the femur which he implanted into the defect twenty minutes after the amputation. A year after the grafting there was a small fistula upon the interior face of the thigh. The patient has resumed his occupation as a vender and gets about on two canes, the limb being strengthened by a leather apparatus.

Macewen in his book mentions a living homoplastic transplantation in a boy, the whole of whose diaphysis he was compelled to remove for necrosis. There was no subsequent osseous deposition. Fifteen months later he was readmitted with the request by his parents that his useless arm be removed. Two wedges of bone were excised from another patient, six years of age, afflicted with anterior curves. The wedges were cut into minute fragments, quite irrespective of the periosteum, and were then deposited into the muscular sulcus in the boy's arm. There was no pus formation. Two months later a portion of new bone, an inch in length and three-

quarters of an inch in thickness, was found firmly attached to the upper fragment of the humerus. Here all the grafts proliferated, grew to one another, and also to the extremity of the proximal portion. Two other wedges of bone of larger size than the first were similarly dealt with and inserted two months subsequent to the first graft, and a third couple were placed in position five months after the first. These all fused together and to the condyles of the humerus, filling the gap in the arm to the extent of four and one-fourth inches. It is now 30 years since the humeral shaft was rebuilt, and during all this time the man has depended upon his physical exertions for the earning of his living. He worked as a joiner for many years, and is now an engineer's pattern-maker.

Trout reports a very successful transplantation of a section of a father's tibia into a spina bifida of his child.

DEAD HOMOPLASTIC TRANSPLANTS EITHER BOILED OR IN ANTISEPTICS

Von Bramann implanted into a humerus defect a 16-cm.-long piece from fibula which had been boiled for two hours. The result was successful.

Friedrich resected the entire right femoral diaphysis and implanted a dead fibula from a tuberculous boy, with good result. He also resected 12 cm. of the femoral diaphysis. Into this defect was implanted a boiled 15-cm.-long femoral diaphysis of a 65-year-old man who died of carcinoma. Perfect healing in of the implant resulted.

Franke implanted into a resected defect of the carpus, dead bone. No result. Then autoplasty from the tibia with good result.

Kausch in 1906 reported up to that time the greatest case of implanted dead bone which healed in the tissues. A 9-cm.-long piece of the whole diameter of a tibia was obtained the day before from an amputation. It was boiled and then implanted between the resected tibial and femoral ends, which were held by ivory pegs. Primary union resulted. Three-quarters of a year later there was a recurrence. Amputation was performed. Autopsy showed good healing in of the transplant, which was surrounded by new formed periosteum. Case 2. Pseudarthrosis of the tibia. Implantation of a freshly obtained phalanx from a previous operation. The bone was boiled; as fistula developed, the implant was removed. Case 3. Sarcoma of the upper arm. Implantation of two sterilized cadaver humeri. Removal of the same after five months on account of fistula formation. Case 4. Sarcoma of the upper arm. Resection. Implantation of a freshly obtained cadaver humerus which was boiled for an hour. Removal after one month on account of infection. Case 5. Sarcoma of the internal femoral condyle. Oblique resection of this condyle. Implantation of an old anatomical lower femoral bone which was boiled. Removal of the same on account of purulent secretion on the eighteenth day. Case 6. Sarcoma of the lower femur. Implantation of a boiled anatomical department bone. Removal on account of infection.

Grosse implanted in a pseudarthrosis of the tibia, a living exostosis from a 10-year-old girl. There was primary union but absorption of the graft. The same result occurred after implanting a section from an amputated ulna without periosteum. Complete consolidation occurred after the implantation of a boiled piece of a tibia without periosteum from an amputation. Eleven years afterward the röntgenogram gave a single shadow of the tibia.

Stieda implanted in a pseudarthrosis of the arm of a girl, a 16-cm.-long piece of a boiled fibula from an amputation. After a year there was a pseudarthrosis at the upper end of the implant. There developed a fistula with final sequestration, compelling the removal of the dead implant.

Küttner resected the entire super extremity of the femur for sarcoma in a man 31 years of age. He replaced the segment of resected bone by the upper extremity of a masculine femur, taken aseptically from a cadaver, 11 hours after death. This segment was preserved for 24 hours in Ringer's solution with chloroform added. The dead femur was united to the remains of the healthy femur by an intramedullary ivory dowel and the tendons were united to this graft as far as possible. Death occurred thirteen months later from metastases. Autopsy of the graft showed perfect insertion of the muscular tendons of the bone into the dead graft. The functional result was very good and the patient, six months after the operation, could make numerous movements of the hip. The microscopical examination of the fragment of the dead graft showed that it was "little living," and it is very probable that this dead bone was simply tolerated as an aseptic foreign body. Its utility had been considerable, since new muscular insertions were made on its surface and functionally it fulfilled its rôle.

Brewer (Fig. 1) in an as yet unreported case, made the following very interesting homoplastic dead bone transplantation of which the röntgenogram is here reproduced. On January 27, 1912,

he resected the lower two and three-eighths inches of the right radius for a giant-celled sarcoma, removing the entire periosteum with the bone. Three days later a suicide was brought into the hospital and from this corpse was removed a corresponding section of radius, which was then boiled for an hour and kept in sterile salt solution. On the seventh day after the first operation, this dead sterile section of radius was transplanted into the defect in the patient's radius. It was simply placed into the defect and the soft parts were sutured snugly around it. The healing was by primary union and there was never the slightest discharge from the implant. The röntgenogram was taken in July, 1915, three and one-half years after the transplantation. It shows that the proximal end of the transplant is firmly united to the distal end of the old fragment and, roughly, one and three-eighths inches have remained alive, or, rather, osteogenesis has proceeded along the transplant this distance from the old living bone. At this point osteogenesis apparently gave out, for the most distal inch is cloudy and feathery and for the most part has disappeared; that is, absorption has outstripped regeneration. To make up for this defect of an inch the carpus has become dislocated upward and outward from its articulation with the ulna, pronation and suppuration being almost lost. The hand and fingers are very much restricted in their motions and have little strength. It has been proposed to the patient that he undergo the transplantation of his own fibula into the defect, the articular surface of the fibula to rest upon the carpus. Since the muscles of the forearm are probably so much shortened that it will be impossible to replace the carpus upon the ulna, it has been suggested to either remove entirely sufficient of the corresponding lower extent of the shaft of the ulna to allow reduction to be made, leaving the articular surface of the ulna *in situ*, or, since the ulna adds very little in strength to the wrist-joint, a resection of the lower end might be done. One or two authorities maintain that osteogenesis proceeds from the surrounding tissues. If this be the case it is pertinent to ask why in Fig. 1 regeneration was perfect in section D, imperfect in C, while there was none at all in section B?

Streissler reports a case of comminuted compound fracture of both bones of the leg, resulting in a defect of 5 cm. in the tibia, and with overriding of the fibula fragments. After several months the granulating wound was opened, the tibial ends were freshened and the attached fibula ends separated. A 10-cm.-long section from a tibia of a fresh amputation was boiled for 20 minutes in soda solution. The graft was then doweled in the upper and lower medullary cavities and fixed by silver sutures. The granulating surface soon became closed in. Progressive radiograms showed lacunar arrosions of the graft with gradual absorption. The upper tibial fragment became consolidated with the lower fibula fragment. The remains of the dead graft were finally removed. The fibula gradually increased to three times its normal dimensions, and bore the entire body weight.

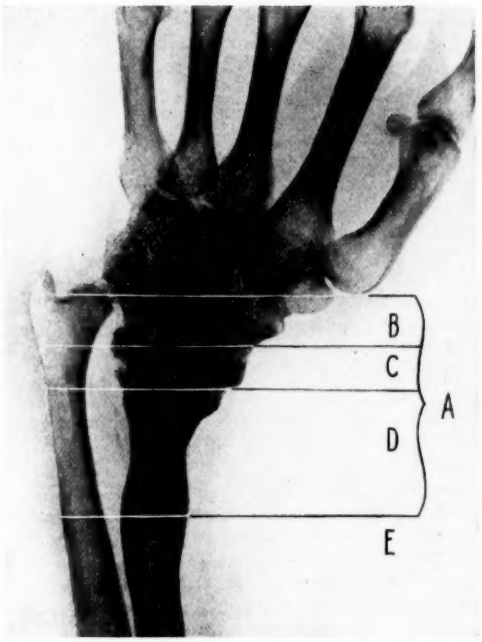

Fig. 1. Brewer's case of boiled homoplasty, three years after grafting. A represents the entire 2⅜-inch graft; B, the completely absorbed and entirely unregenerated portion of the graft; C, the partly absorbed and but partially regenerated bone, osteogenesis being apparently unable to fully traverse the distance to C; D is the perfectly regenerated portion of the graft. Osteogenesis must have come from E, the portion of contracting old bone, since the periosteum from the resected bone was removed with the tumor. According to one or two authorities, osteogenesis comes from the surrounding tissues. If this be the case, why was osteogenesis not as perfect at B or C as at D?

AUTOPLASTY

Autoplastic bone transplantation is the grafting into an individual of a piece of bone taken from

some other region of the same individual. For completeness, the various methods of carrying this out are here given: As a result of evolutionary experience, it has been completely and positively established that all pedicles to assure a sufficient blood-supply, except in some exceptional and noteworthy instances, are unnecessary although they give beautiful results. Free grafts have been proved to be very successful if periosteum be on the grafts and if asepsis be attained. They make a simple operation out of a very complicated one. The importance of the periosteum will be considered later on under a separate heading as will be the influence of infection on grafts. Pedicled flaps are of use in case soft parts in addition to bone are to be supplied; e.g., in the treatment of gunshot injuries of the face and jaw as well as in loss of both soft and hard parts of the nose. These flaps are usually temporary in character. In other instances the flaps may be permanent, in which case they may consist of skin, periosteum and bone, or they may consist of skin, muscle, periosteum and bone or muscle, periosteum and bone.

1. *With temporary pedicle.* Reichel in a defect of the tibia formed a flap of skin containing periosteum and bone from the opposite tibia. This was transferred into a defect in the opposite tibia and the bridge of skin, which assured a good blood-supply to the graft, was later divided. Coenen in two cases of defects in tibia performed the same operation. Likewise Nové-Josserand, Van Mangoldt, Lambotte, Hashimoto, and others have performed the same operation.

On pages 24 and 25 will be found various temporary pedicled flaps for the formation of a new nose.

On page 32 will be found a method by Nikoladoni of replacing a lost thumb by the second toe by making use of a temporary pedicle.

On page 26 will be found methods of filling a defect in the lower jaw by temporary pedicled flaps, and on page 29 the same procedures for defects in the humerus.

Nové-Josserand: Pseudarthrosis following osteomyelitis of the right tibia. Freshening of fragments, union with silver wire. Osteocutaneous flap formed from left tibia with external base, fastened to the fragments with two silver wires. Section of the cutaneous bridge 113 days later. Consolidation was slow but finally good.

Codivilla: Osteomyelitic loss of substance of tibia. Osteocutaneous graft à la Reichel from the opposite tibia. Consolidation complete.

Coenen: Ununited fracture of the tibia. Graft à la Reichel — temporary pedicle — taken from the opposite tibia. In the flap was the crest of the tibia with longitudinal pedicle over the fibula, the graft being fixed in place by periosteal and cutaneous sutures. Section of the pedicle was done in three stages: six, nineteen, and twenty-one days after the operation. The result was good.

Bardenheuer and Feinen: Fracture of the middle third of the humerus. A pedicled flap made from the chest, containing the third rib, was sewed into the humeral defect. After two months section of the bridge was done, with good result.

2. *With permanent pedicle.* A graft with a permanent pedicle most nearly approaches the ideal.

Codivilla reports an united fracture of the middle third of the tibia of nine months' duration. A fragment of the fibula which was pedicled by the soft parts was resected and fixed by periosteal sutures to the external surface of the tibial pseudarthrosis. Consolidation was complete. Codivilla reports two successful cases of defects in the humerus filled by transplanting the external border of the scapula, pedicled by the neighboring muscles. Consolidation was complete in each.

Bardenheuer reports a defect of the upper half of the humerus, including the head, with loss of periosteum. The defect was filled with a graft consisting of the spine and neighboring body of the scapula, together with the neck, consisting of a third of the joint surface. The hinge, which was at the acromioclavicular joint, was turned down and fastened to the humerus. There was a permanent pedicle. Three such cases were done by Bardenheuer successfully.

Curtilliet describes a case of ununited fracture of the middle third of the leg. A graft of the superior part of the tibial crest with musculo-aponeurotic pedicle whose base was at the level of the pseudarthrosis, was carried through the anteromuscular mass and fixed in the defect with metal sutures. There was a good result after a year in spite of suppuration requiring incision.

Lambotte reports a pseudarthrosis of the leg in which two periosteal flaps were reflected from the vicinity of the fracture over the fracture. No consolidation resulted. A year later, an osteo-periosteal flap was made from above the fracture which was fixed over the fracture by two screws. Aseptic healing resulted, and the screws were later removed. Consolidation resulted.

Lotheissen tells of a case of loss of substance from osteomyelitis with non-union of the femur. A pedicled osteocutaneous flap was formed from the upper flap which was twisted so as to fit into the defect and fastened by periosteal sutures.

Consolidation was complete in twelve months (see under femur). The same pseudarthrosis (traumatic) of the leg. Loss of tibial substance. An osteocutaneous flap with large pedicle from the lower fragment which is twisted upon the fracture and there fixed with periosteal sutures. Four months later consolidation was still incomplete (see under tibia).

Codivilla in a case of pseudarthrosis subtrochanteric of the femur transplanted a part of the iliac crest pedicled by a flap of the gluteus maximus. It was fastened upon the external face of the femur across the pseudarthrosis. Consolidation followed.

Kauert reports a case of pseudarthrosis of the same right tibia in which he resected a section of the fibula one-half as great as the defect to be filled, retaining the periosteum *in situ*. Care was taken that the connection between the section and the soft parts and interosseous ligament, so far as possible, should be retained. This fibula section was then passed through a hole made in the interosseous ligament and laid between the two freshened tibia fragments. Fixation was afforded by means of a plaster splint. Two years afterwards there was a beautiful result. Consolidation was rapid and perfect and the lad could walk as well as ever. Röntgenograms showed complete bony consolidation in which the graft was buried. The picture shows the gradual complete absorption of the graft and its replacement by new bone.

Stuckey reports a case of pseudarthrosis of both bones of the leg in the middle third. A large skin-flap with base above was formed, at the same time there was taken a bone-plate from the inner front surface of the tibia, after which the entire flap was swung upward. In the marrow canal was inserted a dowel *without* periosteum which had loosened itself from the tibia in the formation of the bone-plate. In the medullary cavity of the fibula was inserted a thin bone-plate.

See under clavicle, page 29, a case by Witzel in which he transplated the spine of the scapula into the clavicle.

TECHNIQUE OF AUTOPLASTY WITH PERMANENT PEDICLE

1. Ollier's operation *par renversement* (Fig. 2). Expose the ends of the bone and excise the fibrous tissue between them. With a fine saw cut from one fragment a thin slice of bone after freshening the opposite end. The slice of bone is hinged by the periosteum at the other end of the saw line. The triangular wedge of bone is then turned downward and its apex is sutured with chromic gut to the raw bone surface below, or it can be pushed into the medulla. As much as two inches of bone may be replaced by this method. The periosteum is the permanent pedicle.

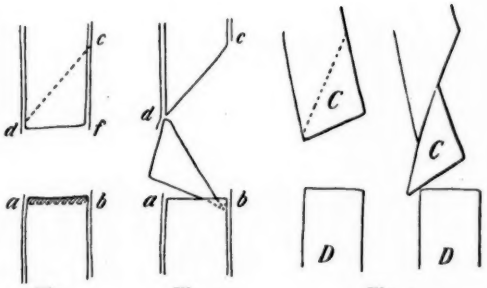

Fig. 2. Fig. 3. Fig. 4.

Fig. 2. Ollier's operation *par renversement*. A the osteo-periosteal flap, *d c f* is hinged at *d* and reflected down in B until *f* comes in contact at *b*.

Fig. 3. Ollier's operation *par glissment*. The triangle C is cut pedicled by the soft parts and reflected down and brought in contact with D.

Fig. 4. Ollier's operation *par implantation*, applicable only to two parallel bones. The triangle D is reflected over, pedicled by the soft parts, into the freshened sides of the opposite fragments. (From "Binnnie's Operative Surgery.")

2. Ollier's operation *par glissment* (Fig. 3). Freshen the end of each fragment and remove the fibrous tissue. From the upper end cut a triangular piece of bone with periosteum on it, but do not separate this portion of bone from its connection with the soft parts. Slide this piece of bone downward and suture it to the lower fragment.

3. Ollier's operation *par implantation* (Fig. 4). This is only suitable when one of two parallel bones is the site of a defect. The sides of the ends of the fragments are obliquely vivified opposite the bone from which the transplant is to be taken. These surfaces make two sides of a triangle. From the opposite healthy bone a triangular piece of bone is cut which retains its connections with the soft parts. The graft is turned and implanted into the defect, where it is sutured.

4. Müller's two operations. The first is made by turning the flap which consists of skin, periosteum, and bone, the pedicle being permanent. The ends of the fragments are exposed by a vertical incision which projects upward and downward, covering half an inch of the surfaces of each fragment. Remove all scar tissue interposed and freshen the ends and sides of the bone with a chisel. On the surface of the upper fragment outline a tongue-shaped flap, cutting through the periosteum with a knife. The pedicle, consisting

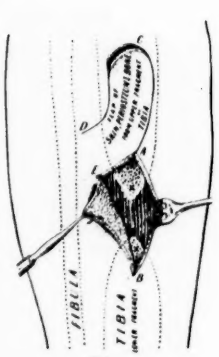

Fig. 5.

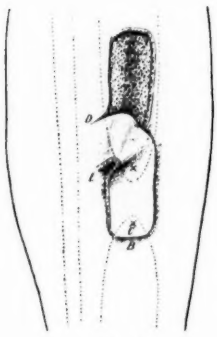

Fig. 6.

Figs. 5 and 6. Müller's first operation, made by turning the flap, the pedicle being permanent. (From "Binnie's Operative Surgery.")

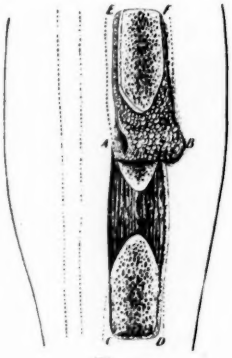

Fig. 7.

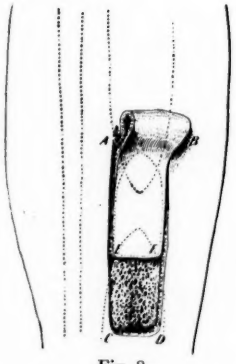

Fig. 8.

Figs. 7 and 8. Müller's second operation, in which the twisting of the pedicle is avoided. (From "Binnie's Operative Surgery.")

of skin, is off to one side. With a chisel introduced through the upper flap incision cut a slice of bone corresponding to the skin incision. Rotate this flap so that it bridges the osseous defect and fasten the bone in the flap to the raw surfaces of the fragments with chromic gut. Undermine the edges of the upper defect so as to bring them together, or close it by Thiersch's grafts.

The second method of Müller is one in which the twisting of the pedicle is avoided. Make a V-shaped incision, the open part of the V being about two inches below the end of the lower fragment and projecting upward the same distance in front of the upper fragment. Carry the incision through the periosteum below and raise a slice of bone with the chisel from in front of the lower fragment. Elevate the flap, expose the defect between the fragments, remove the fibrous tissue, vivify with the chisel the ends of the bones and the front of the upper fragment. Carry the incision upward through the skin only on the surface of the upper fragment and loosen this part of the flap. Draw the flaps up until the bone in the flap bridges the defect in the upper and lower fragments. Suture the bone in this position. Carry the incision upward until the redundant portion of the upper part of the flap can thus be smoothed out. Undermine the edges of the lower defect and bring them together or Thiersch graft them. This operation has given Müller, Sprengel, and von Eiselsberg splendid results.

These operations are not of frequent applicability. If the defects are over 4 or 5 cm. they will be impossible. An objection which strikes one is the increased liability to infection, owing to the Thiersch grafts, or to tension of the sides of the defect, as well as to the small raw surfaces which are liable to be left at the sides.

Müller has performed 13 of these transplantations for pseudarthrosis according to his method. Of these, 12 were very successful, consolidation quickly following. One only was unsuccessful, due to necrosis of the flap.

5. Hahn's or Huntington's operation: (See under tibia, page 35.)

CODIVILLA'S OPERATION

This consists in surrounding the pseudarthrosis with very thin osteoperiosteal plates taken from the internal face of the tibia. The periosteal sheets should be 3 to 4 mm. in thickness, and long enough to be fixed on each fragment by two sutures about 1 cm. distant. This method employed by Brade, Ranenbusch, Codivilla, and others, can be applied only to loss of substance no greater than 3 cm. It is the choice of method in congenital pseudarthrosis and it has been employed in some cases of acquired pseudarthrosis. Delagénière has transplanted an osteoperiosteal sheet as thin as a piece of paper which he has rolled about the pseudarthrosis, a procedure which has habitually succeeded with him. Codivilla has published a number of reports of patients operated upon by his method with success.

Streissler says that grafts of periosteum alone, as we have known for a long time, will produce new bone.

Brade of Breslau reports a case of pseudarthrosis with an osteomyelitic loss of substance of the tibia. Suture with silver wire surrounded by a

flap of periosteum without bone taken from the opposite tibia resulted in perfect consolidation.

IS PERIOSTEUM NECESSARY FOR THE SUCCESS OF GRAFTS?

This question has elicited the greatest amount of discussion and a wide variety of opinions have been given, backed up by animal experiments. The answer seems to hinge on the question of the presence or absence of the bone-cell from the deep surface of the periosteum. Some say that if, when the periosteum is removed, bone-cells adhere to its deep surface, then the periosteum will produce new bone; if none adhere, then the periosteum will not produce new bone. Is not this splitting hairs, for what is the *bone-cell* under the microscope? Can it be differentiated in any other way than by what it *produces* from the connective-tissue cells? Is it any more than a highly specialzed connective-tissue cell? The periosteum is a connective-tissue membrane, hence why should it not produce the more highly developed bone-cell?

Axhausen attributes to the periosteum the first place in osteogenesis, second, the marrow retained on the graft, and third, the bone building tissue of the surroundings.

Lobenhoffer examined microscopically the periosteum in a transplanted human fibula graft, eighty-six days after the transplantation. As a result he is convinced, as many others are, that the bone tissue of the transplant dies and only the periosteum remains alive which is the foundation for the new formation of bone and the final replacement of the dead bone by living new bone. He took a microscopical section of the graft and found that the periosteum alone of the graft had produced new bone while the bone tissue of the graft was in the way of necrosis and progressive absorption.

In the beginning of this article the authorities have been cited who do not believe in the osteogenetic properties of the periosteum. It will be instructive to see why they draw this conclusion. Gallie and Robertson, Bancroft, Davis and Hunnicut, Murphy, Brown and Brown, and finally, Groves have never made a reported human transplant *without* periosteum. The opinions of most of these authorities are based solely on animal experimentation and the remainder on conclusions drawn from human transplantations *with* periosteum. The question at once comes up why have not these surgeons made human transplants *without* periosteum if the periosteum has so little function? A careful search of the literature by the author reveals very few reported transplantations made *without* periosteum. These are as follows: Baschkirzew cites a successful case, after four years, of transplantation without periosteum.

Wetherill also reports a successful case as follows: A graft was taken from the opposite tibia without periosteum and transplanted into the medullary cavity above the affected tibia and spliced to the lower fragment. Six months later, despite suppuration, röntgenograms show that the graft has lived and has increased in size.

Delbet has followed by frequent röntgenograms during more than a year an intra-osseous graft from the tibia without periosteum, 9 cm. long. The fragment has always been clearly visible, it has preserved its form, its dimensions, and its opacity. The proof that it is not dead is that it became fractured and that this fracture became well consolidated.

McWilliams has made four human transplantations without periosteum, and all these grafts became speedily absorbed. These cases have already been published. The first case had a piece of rib without periosteum grafted into a defect in the lower jaw. In five months the rib had entirely disappeared. The second case had a piece of rib without periosteum grafted into the inguinal canal to strengthen a hernial repair. In four months the rib was entirely gone. The third case was originally one of an infected compound fracture of the humerus with necrosis and non-union. After the sinuses were all healed, a rib without periosteum was grafted into the medullary cavities of the fragments. After nine months there was no union and the rib was honeycombed and showed no regeneration of new bone. The fourth case was non-union in a birth fracture in a child. Into the defect was transplanted a piece from the opposite tibia without periosteum. It was inserted into the medullary cavity of the upper fragment and spliced to the side of the lower fragment. The graft gradually melted away in the tissues, so that after six months it was not more than one-quarter its original size. All these four cases healed by primary union, so that one can say that there was lacking some element to produce osteogenesis. It seems reasonable to assume, consequently, that, since the periosteum was all that was wanting in these four cases, it is the periosteum which conduces to osteogenesis.

McWilliams questions very much whether the results of transplanting bone in dogs can be transferred to human beings with as exact a similitude as most experimenters have maintained. Non-union of a fracture among animals is a great

rarity, if not almost unknown, while quite the contrary condition prevails among human beings. Is it not irrational for a surgeon to make transplantations in the human being *with* periosteum and after these grafts have lived to maintain that the periosteum has had little to do with the life of the grafts when he probably never has made a transplantation *without* periosteum in the human being, as the paucity of such transplantations in the literature will testify. Probably many more have been performed *without* periosteum and because of their failure have not been published.

Jokoi gives his results of injecting emulsions of periosteum in animals: The injection of an autoplastic periosteal emulsion in 10 experiments gave a new bone formation more or less considerable, 6 times. The injection of an homoplastic emulsion of periosteum can also cause a new bone formation but with less constancy (2 of 6 experiments) and less intensity than autoplastic injections. Heteroplastic periosteal emulsion injections constantly gave negative results.

It is interesting to observe the different results obtained by various operators as a result of transplanting *periosteum alone in animals*. The utter confusion existing as to the exact composition of the periosteum evidently explains the differences in the results because of the variations in method of the several operators in obtaining periosteum. All operators have neither included nor excluded the same components, due to the varying methods of removing the periosteum.

The following table shows these differences:

Operators who have produced new bone in animals by transplanting periosteum alone:

Trinci,
Carrel,
Pochhammer,
Berthier,
Jokoi,
Nakahara and Dilger.
Haas,
Schepelmann,
Ryerson,
McWilliams,
Meyer and Wehner.

Operators who have produced no new bone in animals by transplanting periosteum alone:

Gallie and Robertson,
Davis and Hunnicut,
Brown and Brown.
Baschkirzew and Petrow,
Macewen.

Macewen transplanted small bone chips without periosteum in a humerus with successful result. The details of this case will be found under the method of bone transplantation with small chips. (See page 13.)

Vallas, in a pseudarthrosis of the tibia, transplanted into the defect 10 to 12 small chips taken from the superior fragment. Consolidation resulted in six months.

RESULTS OF INFECTION ON BONE-GRAFTS AND THEIR USE IN INFECTED AREAS

The original idea that transplants should be grafted only into clean uninfected wounds must be somewhat revised, according to the latest clinical evidence, as well as the idea that infection necessarily means the death of the whole graft. If the graft be *without* periosteum it will probably entirely die. If it have periosteum on it, then there may be a superficial necrosis of the bone but the periosteum may furnish sufficient blood to the bone of the graft to cause a greater resistance than it would have without the periosteum, consequently less of the bone will die. There may be some superficial necrosis which either the periosteum or the surviving bone-cells of the graft will regenerate. The chances however, are, more than ever that the graft may entirely die.

Lewis has emphasized the effects of infection in the two following cases: The first one was in a patient who had some plates put upon an ulna and radius with infection and sequestration of each. In the operation and removal of dead bone so much radius was removed that subsequent radial deviation of the hand was feared and a transplant (with periosteum) was removed from the tibia and inserted into the defect to act as a mechanical support. Even if it had been necessary later to remove the graft it would have served a useful purpose. Later, two small sinuses formed and several small cortical sequestra were removed. Union was firm in six months. The second case sustained a compound infected fracture of the radius, from which a tubular sequestrum was removed. In order to prevent radial deviation of the hand, a transplant measuring about four inches in length was at once removed from the anteromedial surface of the tibia and transplanted into the defect and the wound drained. A sinus remained about the wrist for some time, but later closed without any sequestration. The transplant, as shown in the röntgenograms, has apparently increased in size and has survived in the infected wound.

Lewis remarked about these cases: "Bone-grafts inserted into infected fields will live, and even if sequestration formation occurs, necessitating operation later, they have acted as a mechanical support, preventing deformities, and the convalescence is materially shortened. Infection introduced at the time the graft is inserted has a much more harmful effect and the entire graft or the greater part of it is apt to be lost. The autoplastic graft used in the treatment of old compound fractures, as in the last two cases

cited, seems to have developed a certain amount of immunity to the infection, or perhaps the virulence of the infection has been greatly reduced.

In a case reported by Axhausen, an attempt had been made to replace the upper end of the humerus after resection for reccurrent cancer by a metatarsal bone. A mild infection occurred, and in spite of the fact that the transplant was surrounded by pus total sequestration did not occur. Sequestration of the head of the bone resulted but the shaft healed in position and a firm union was established between it and the shaft of the humerus.

Klapp reports a case by Bier, in 1897, who removed the whole diaphysis of the humerus with the greater part of the periosteum for sarcoma. Subsequent to transplantation of a graft from the front surface of the tibia, two fistulæ subsequently developed and finally there was sequestration of a fragment 3 cm. long and 2 cm. broad. Twenty-two months after operation there was complete consolidation with the formation of a complete shaft.

Von Mangoldt reports a case of non-union resulting from osteomyelitis of the tibia. After it was healed, he joined the fragments by a wire and interposed a graft taken from the opposite tibia. A fistula developed with sequestration. Consolidation was finally perfect.

Von Bramann reports transplanting a graft from the tibia to fill up a 7-cm.-long total defect in the humerus resulting from a comminuted fracture. Notwithstanding suppuration, fistulæ, and extrusion of a small sequestrum, the humerus consolidated perfectly in three months.

Curtillet in a pseudarthrosis of the tibia transplanted a segment of the adjoining fibula which was pedicled by a muscular flap carried through the anteromuscular mass and fixed in the defect in the tibia. Consolidation was perfect in spite of suppuration requiring incisions.

Lambotte in a case of pseudarthrosis of the left tibia transplanted a free osteoperiosteal flap from the right tibia and fastened it to the freshened sides of the fragments by screws. Consolidation was complete below; slight suppuration above caused delay but finally there was complete consolidation.

Heidenhain in an osteomyelitic loss of some of the tibia transplanted an osteoperiosteal flap from the opposite tibia. Consolidation resulted in spite of suppuration and sequestration.

Wetherill also reports (See page 19 of this article) a successful graft made without periosteum, which, despite suppuration, lived and increased in size. He states that even the limited, low grade infection which occured at the lower extremity of the graft where there was splicing only between the fragments, which infection still persists (six months after operation), has not interfered in any way with union between the graft and the diaphysis and, though the union at the upper end was uninfected, it is not so firm or satisfactory. It would seem that this infection had stimulated osteogenesis rather than diminished it.

Tomita reports a case with bullet wound in front of the inner surface of the junction of the middle and lower thirds of the right leg. Suppuration and sequestration followed, requiring incisions and drainage. The wounds finally healed, leaving a defect 6 cm. long with abnormal movability. The defect was filled with a 8-cm.-long by a 2-cm.-wide graft, removed with periosteum and marrow from the upper fragment. This graft was implanted into the medullary cavities of the fragments. Drainage was instituted, but the wound became infected and the edges separated producing a large granulating cavity, at the bottom of which a 2 to 3-cm.-long bone-graft lay. Out of this area finally sequestrated a small superficial piece of the graft, after which the wound promptly healed. Firm consolidation resulted, and the patient was walking without crutches the twenty-third week.

Brentano reports a case of pseudarthrosis of the left arm in which several operations had been done unsuccessfully. There was a 6-cm. shortening, and a graft with periosteum from the patient's own tibia was implanted between the freshened bone ends. Fixation was made solely through periosteal sutures. Drainage was instituted. Several months after the operation an abscess developed in the scar, which only healed when a small finger-sized sequestrum was discharged. The convalescence was also disturbed by erysipelas. Despite these complications, the implanted bone has not been extruded but has healed in; yet, after six and one half months, it has not attained a firm consolidation between the fragments.

Murphy reports having severe suppuration in two cases about the grafts, but with the aid of autogenous vaccines and the resistance of the patient, asepsis was again attained and the grafts survived.

Hashimoto reports a case of comminuted rifle wound of the humerus which suppurated. Removal of the fragments left a defect of 2 cm., which was filled with an osteoperiostal segment from the patient's tibia, the fragments being first united with silver wire. The periosteum of

this graft was fixed to the humeral defect by catgut. The wound suppurated but there was no sequestration. It finally healed, with firm consolidation. Röntgenograms taken 19 months after grafting showed extensive new growth of bone with firm consolidation. Hashimoto also reports a second bullet wound of the arm with comminution. Suppuration and removal of fragments left a defect 3 cm. long. The fragments, after healing of the wound occurred, were united by a silver wire and an osteoperiosteal piece of the patient's tibia was placed in the defect and periosteum was sutured to periosteum. The wound suppurated, and the silver wire was extruded but there was no sequestration. Röntgenograms taken three months later showed an increase in the bone of the graft with some movement between the fragments.

A successful case combining a heteroplastic transplantation of a kid's bone with a homoplastic graft from an asphyxiated new bone fœtus is given by Poncet on page 10. The grafts were transplanted into a granulating defect in the tibia.

Schulze-Berge resected in a 20-year-old patient the upper tibial third for spindle-celled sarcoma, freshening the femoral condyles and the fibula as in a knee resection. He transplanted into the 8-cm.-long defect, a corresponding piece from the fibula of the healthy side. In the beginning there was suppuration, but the wound healed and the graft after a year reached the thickness of the tibial shaft below. The leg was almost ankylosed, there being but a small movement backward and forward. The patient walks easily with a protecting apparatus and a shoe heightened 2-cm. with the sole.

Stuckey reports the following cases:

Case 7. Pseudarthrosis of the middle third of the femur. An 8-cm.-long bone dowel (periosteum not mentioned) was placed in the defect which was taken from the tibia of the same leg. The fragments were united by two bone sutures (material not mentioned). Drainage. Splint. Fistula developed after the operation, out of which on the eighteenth day, a small sequestration was extruded. On the one hundred and twelfth day a bone suture was removed. The fistula closed on the one hundred and fiftieth day. Complete consolidation resulted six months after operation. Case 8. Pseudarthrosis and osteomyelitis of a fracture in the middle third of the humerus. Three weeks after the healing of the fistula, the ends were freshened and a 5-cm.-long bone dowel with periosteum and marrow was inserted into the medullary cavities. Drainage. Suppuration followed. On the eighty-eighth day after the operation some small sequestra were removed. The fistula closed on the one hundred and fifty-seventh day with almost complete consolidation.

McWilliams[1] reports two successful cases of bone transplantations from the tibia into defects in the lower jaw (see page 27). Examinations subsequent to that report show that both these grafts have lived. As to the action of the infection on grafts, these cases are very instructive. In the first of the cases the mouth was not opened in making the transplantation. Metal sutures were used. A slight serous discharge appeared on the seventh day, which became purulent. This was persistent, so on the fiftieth day after operation both wires were removed. The anterior one only was infected. This discharge persisted from one anterior sinus, consisting only of a drop in the mornings, for eight months, when it entirely ceased. There was evidently some slight molecular necrosis of the graft though no bone was ever apparent in the discharge. This necrosis was apparently due entirely to the wires, which were left in 50 days, despite the discharge, for support of the graft. How much infection had to do with the necrosis is a question. Certainly there was very little virulence. In the second case, the mouth was evidently opened at the time of the operation, although this was not appreciated at that time, for the graft became entirely dead and was extruded of itself from the sinus. This shows what an effect on a graft virulent infection has when it is introduced *at the time* of the grafting from the outside.

Fig. 9 is a röntgenogram of the autogenous graft with periosteum of Case 1, taken September 1, 1915, nine months after the grafting. It absolutely proves that infection does not necessarily mean the death of the whole graft. This picture was taken one month after the one interior sinus, which had for eight months discharged but a few drops in the mornings, had completely closed. At E, situated in the anterior part of the graft, is seen a light area evidently the seat of the necrosis of the graft. It comprises a scant half of the graft transversely and three-fourths of its vertical diameter. The remainder of the graft is very much alive. There are seen small metal particles both in the anterior and posterior parts of the graft, evidently some remains of the wires which had been previously removed. How these became disassociated from the wires themselves is hard to tell. At the present time they are causing no trouble. The ends of the graft have united

[1] Surg., Gynec. & Obst., 1915, xxi. 306.

solidly to the fragments in front and behind. The motions of the jaw are normal and the patient can chew without discomfort.

Lewis reports a case in which a compound fracture of the tibia was at first wired and then later a Lane plate was applied which was removed in fourteen weeks because of infection. A sinus remained and non-union persisted. Lewis operated, encircling the sinus and exposing the fracture whose ends were transversely freshened. Each fragment was grooved for the graft which was taken from the tibia itself. Healing without suppuration occurred, the small discharging sinus closing within ten days. Consolidation was slow but finally perfect and röntgenograms indicated that the graft was alive.

Oechsner reports a case of defect in one tibia in which a graft was transplanted from the opposite tibia. The ends of the graft were tacked to the ends of the fragments by nails. There was ultimate suppuration which continued for two months when the wound was opened and several pieces of dead bone were removed as well as the two lower wires. Despite this suppuration röntgenograms demonstrated that regeneration went on uninterruptedly. From a third case reported, Oechsner draws the conclusion that bone transplantation should not be attempted in acutely infected cases. His patient, 6 years of age, had had osteomyelitis six weeks previously. A large volume of the upper surface of the tibia was removed, and, in order to expedite healing, the gap was filled in with a graft taken from the opposite leg. Infection occurred and the life of the patient was threatened. The graft had to be removed in the course of a month but the patient ultimately recovered.

Barnes reports what he claims to be a new procedure in a crushing (automobile) injury to the lower part of the foot. There was a compound, cominuted fracture of the tibia and fibula 2 inches above the ankle-joint. After careful iodine disinfection, the fracture was exposed. Many small fragments without periosteum were removed. One fragment 5.5 by 0.5 inches was removed without periosteum and was preserved. This fragment was found to be long enough to span the gap in the tibia. All the loose bone was removed from the wound, and the removed large fragment was replaced in the medullary cavities of the fragments, being fashioned by chromic gut catgut sutures. There was no periosteum on the fragments. The first dressing was made on the tenth day. There was slight serous discharge but within three weeks the entire wound had healed by primary union. Consolidation at both ends of the graft went on uninterruptedly and röntgenograms demonstrated at successive periods the active regeneration and enlargement of the graft, the last pictures being taken seven months after the operation.

Fig. 9. McWilliams' case of autogenous graft with periosteum into the lower jaw. It was taken nine months after the grafting, and illustrates the fact that infection does not necessarily mean the death of the whole graft if periosteum be on the transplant, for this graft became infected about one anterior metal suture. The suture was removed. The discharge lasted for eight months with the result that E represents only a limited portion of the graft which necrosed. At C and D the graft has perfectly united with the fragments of the lower jaw. It will be interesting to see if E will regenerate and fill up with new bone. The patient has perfect function of the lower jaw.

SKULL

Heteroplastic operations on the skull. Reynier has found a few cases on record in which a large gap in the skull was closed by a plate of bone taken from a dog or other animal, but in none of them is the ultimate outcome known, although the results were eminently successful at first. He reports a case from his own experience in which he repaired an extensive breach in the skull from a shell wound by implanting a piece of bone taken from the scapula of a rabbit, with its periosteum. It was cut to fit the gap and the periosteum of the patch was sutured to that of the skull around. The outcome to date has been perfect.

Sternum flap to close gap in skull. Müller comments on the drawbacks of taking a flap from the skull itself, the harm done the brain by hammering and chiseling on the skull, the unevenness liable to be found when a flap is twisted around, and the difficulty of cutting a flap just the right size. These disadvantages are obviated by securing a flap elsewhere, and the sternum is especially adapted for the purpose. It is easy of access and the spongiosa structure permits a flap to be readily scaled off. He has applied the method in two cases and was surprised at its advantages. In one case he used a sheet of fat to substitute the dura; over this he fitted the sheet taken from the sternum, setting it in the gap which it smoothly filled; it soon bent to conform to the curve of the skull. The defect measured 2.2 by 6 cm. The work was all done under local anæsthesia.

Schroeder has successfully transplanted a piece of the scapula into the skull.

Rhodes reports four cases treated by grafting rectangular grafts from the tibia with periosteum and marrow into defects in the skull.

Tomita calls attention to the remarkable rapidity with which the periosteum of a graft unites firmly to the surrounding soft parts. In a skull defect he transplanted a piece from the tibia with periosteum. This piece was pushed up by the prolapsing brain. On the third day skin sutures were taken away. The wound edges separated, the graft remaining firmly attached by its adherent periosteum to the surrounding skin.

The covering of large defects in the skull by celluloid plates. Funke[1] says that in all small defects of the skull the autoplastic graft is to be preferred above all other methods. In large defects it is almost impossible to form a single large bone shell to answer the purpose. Usually it must be broken into several pieces, which when the dura is intact, may give rise to troublesome deformity. Celluloid plates heal in most cases without trouble and may remain many years, seven years (Hinterstoisser), eight years (Franke). Funke had one case which caused trouble after ten years. A sinus developed. At operation to close the persistent sinuses, the plate was found broken in several places and its consistency was changed.

Cliak of Petrograd[2] says that in fractures of the vault of the skull, the best method of autoplasty consists in reimplanting the removed fragments. In 20 such procedures he has had 16 complete successes, one unsuccessful because of extrusion of the infected fragments, and 5 died because of suppurative meningitis in patients operated on at the end of two or three days who were already profoundly infected.

[1] Zentralbl f. Chir., 1915, xlii, 257.
[2] J. de Chir., 1912, Nov., 572.

NOSE

A number of methods have been employed in forming a new nose. Lothrop's method is as follows: A strip of bone, 2 inches long and about .04 of an inch wide, was removed by Lothrop from the free vertebral border of the scapula with bone-cutting forceps and wrapped in wet, sterile gauze. The attachments of the muscles were first cut from the border and from the external and internal surfaces, great care being taken not to denude the bone of its periosteal covering. A subdermal passageway was made in the nose bridge extending to the distal extremity of the nasal bones. At this point the periosteum of the nasal bones was cut and elevated along the crest of the nose bridge up to the frontal bone. The nasal bones were then ground down with a rasp, the graft being inserted through this passageway and under the periosteum until the end reached the frontal bone. In three weeks the graft was quite solid and in four weeks it was very rigidly held in place on the nasal bones and the dressing was omitted.

Carter has devised the best method of correcting a saddle-nose where the soft parts are intact, the bony framework being gone. His description is as follows: A curvilinear incision, convexity downward, is made between the eyebrows, extending down to the periosteum over the frontal bone. Lifting the flap up, a transverse incision is made through the periosteum and into the bone. This incision is at a point just below the glabella. Above the incision the periosteum is elevated for about three-eighths of an inch. With a sharp elevator the skin and subcutaneous tissues are then elevated over the dorsum of the nose, to an extent corresponding to the degree of the deformity, over the sides of the nose and in some instances over the cheeks. If any of the nasal bone is left its periosteum should be elevated so that the bone-graft, when it is introduced, will lie in close contact with the raw bone and its torn periosteum. Two inches of the ninth rib are then removed, preserving the periosteum on the outer surface. This piece of rib is then split in its transverse diameter, the outer half being shaped to suit the deformity. The bone-graft is then inserted nearly to the tip of the nose, and the upper end is carefully placed beneath the periosteum over the frontal bone. The semilunar flap is then brought down to its

place and the wound is closed with horse-hair sutures.

Israel made a new nose by bringing the forearm up to the head where it was held by a plaster. On the ulnar side of the forearm he formed a flap pedicled toward the elbow. He then chiseled out of the ulna a piece of bone which he left attached to this flap. The pedicled flap was then sutured in place, the bone in it acting as a support for the new nose.

Several operators in making a new nose have tried the preliminary inlaying of one or two thin bone-plates (taken from the tibia), under the skin of the arm or forearm. After these have healed in place, a large pedicled flap is circumscribed about them and the raw surface of this flap is skin-grafted. Later this pedicled flap is bent like a roof as near the transverse configuration of the normal nose as is possible and is sewed by its edges into the defect in the nasal structures.

Lexer has attempted to make a new nose in an ingenious manner. He saws from the anterior surface of the tibia (where it is triangular in cross-section) a piece of bone of appropriate size. This is then slipped under the skin of the arm or forearm where the hair is nearly absent, and allowed to remain there for three or four months until the skin and bone have united quite firmly. In another still freer way, Lexer made a rhinoplasty in which he made a whole scaffold for the nose from the lower epiphysis of an amputated femur. The *Gelenkknorpel* formed the bridge and the tip; the side walls of the new nose were made of spongiosa, while the interior of the future nose was bored out with the "fraise." This bone transplant was put under a thin layer of skin in the forearm, which covered it on the outside, while its inner side was covered by a flap of the muscle. After this substitute nose had healed for several months in the arm, it was transplanted to the face.

Abbe[1] exhibited a patient showing the result of completed plastic repair, following extensive removal of cancer of the nose. The entire surface of the nose from between the eyes to the nostrils and from cheek to cheek was eaten away. In closing the defect preference was given to the double transplantation flap method of Steinthal on account of the ample flap to be obtained. Two vertical incisions, five inches long, three inches apart, were made over the upper sternum, the lower ends being joined by a cross-cut and a thick flap raised which included periosteum and a strip of bone chiseled up with the flap. The left forearm was brought up so that the hand rested on the right shoulder, and an incision was made in the skin of the forearm, corresponding to the lower edge of the sternal flap. Close suturing of this flap edge to the edge of the forearm cut was made and the arm and hand fixed to the chest and shoulder by adhesive and plaster-of-Paris dressing. In two weeks the nutrition of the chest was well sustained from the forearm end, permitting division of the upper end from the sternum. Three days were given to promote the best circulation from its forearm attachment and it was then stitched by its freshened edges to the freshened edges of the nose defect, and the forearm fixed to the head by laying the hand flat on a previously applied helmet of plaster-of-Paris. The entire forearm, shoulder, and head were encased in a light plaster-of-Paris bandage. The patient fed himself, as his mouth was free below his fixed hand. In eighteen days the flap had acquired ample nutrition from his face and it was cut away from his forearm. It had a fine vascularity after this second transfer and was then stitched throughout its entire margin to the nostrils and cheeks. Two minor subsequent trimming and suturing operations were done under local anæsthesia and an excellent living healthy ample new nose resulted. The advantage of this method for this case was in having unlimited freedom to cut away the disease, as a flap as large as necessary could be brought up. The disadvantages of this method were: first, a tedious and almost exhausting confinement in plaster casings; second, a not altogether slightly though healthy ample flap repair. The disadvantage of these transferred flaps was that, being cut off from all their original margins, they lost their vasomotor supply and underwent some fibrosis, thus giving them a waxy unnatural pallor which contrasted with the skin of the face. This did not occur with the large flaps of the forehead, turned down on a pedicle between the eyebrows, which were fed by the supra-orbital and nasal arteries without loss of continuity and hence in proper nerve relations with the general vasomotor system. In proper cases Abbe prefers this so-called Indian method of forehead flap.

McWilliams suggests that this double flap method would be ideal in cases where a deficiency in the bone of the lower jaw, as well as a loss of soft parts of the overlying cheek, is to be supplied. The details of the operation would be the same as the above.

The method of forming a new nose by reflecting from the forehead a flap consisting of skin,

[1] Med. Rec., 1915, May 29, p. 921.

periosteum, and bone is well known and described in most textbooks of surgery. Morestin has transplanted a rib into the forehead, and, when this healed in place, a flap consisting of soft parts, containing the rib, was sutured in place in the defect in the nose. Streissler has reported two successful transplantations into nasal defects of bone taken from the forehead pedicled by the soft parts.

Carter has transplanted a rib into the forearm and then this was reflected with the soft parts as a flap into the nose. The pedicle was later divided.

Finney, McGraw, and McWilliams have each successfully grafted a finger into a defect consisting of all the structures of the nose. Baldwin has suggested an improvement of this finger transplantation. He reports two cases. The modification seems very advantageous. It consists in making a double layer of skin so that one layer would be continuous with the cheek while the other would take the place of the mucous membrane on the inside. To accomplish this a flap was made on the abdomen, reversed, and its raw surface then sutured to the raw surfaces on the finger made by reflecting flaps on its ventral surface. The pedicle was later divided and the finger was sutured to the nose. It was later amputated. The final result was "pleasing." McGraw could collect but eleven cases in which a finger had previously been used as a transplant into the nose.

Mandry successfully transplanted in rhinoplasty a skin-flap containing a section of the clavicle.

Streissler reports (Case 23) removing an extensive adenocarcinoma of the nose and nasal cavity. The defect consisted of the entire septum, the left half of the nose, the eye and its cavity and the adjoining part of the superior maxilla. For covering the defect, skin alone would not have sufficed, so a section with periosteum from the patient's tibia of sufficient size to fit the defect was removed. This was transplanted into the subcutaneous tissues of the forearm near the elbow by means of a longitudinal incision. The bone transplant healed in without reaction. One month later the edges of the nasal and cheek defect were freshened and to these edges was sutured a flap formed on the forearm with its base distally directed. This flap contained the bone-graft. The crest of the tibial graft formed the prominent anterior edge of the nose. With aluminum-bronze wire sutures, the graft was fastened to the adjacent bones above and below and the skin edges of the graft were sutured to the freshened edges of the defect. The arm was fastened to the head by means of plaster bandages so that there was no tension on the flap. Sixteen days later the flap was divided. There was primary union of the entire flap, both skin and bone. The result was fine. Streissler has reported two additional cases (Cases 2 and 16) of plastic operations on the nose which were healed by reflecting flaps from the forehead consisting of skin, periosteum, and a small portion of bone into the defects. Later each of these cases had additional grafts from the tibia inserted. The results were good in both cases.

INFERIOR MAXILLA

In cases of loss of the soft parts of the cheek together with more or less bone of the lower jaw, the method given on page 25 by Abbe to supply bone and soft parts for a new nose, will be found very useful. By this method the defects both in the soft parts and in the bone can be supplied. The method consists in taking a part of the sternum, pedicled by the overlying soft parts, and transplanting these into the defect. The advantage of these pedicled flaps over free grafts is that the pedicled bone-grafts may be used in granulating cavities without fear of death of the graft, owing to the abundant blood supply through the pedicle. Free grafts will slough out.

Stillman uses temporary silver prothesis in the lower jaw after partial excision till he can transplant a rib. He has successfully grafted a section of a rib into a defect in the lower jaw.

Berndt has made, in a one-sided resection of the lower jaw, a prothesis out of celluloid. This prothesis was worn for four and one half years without reaction. There were no fistulæ at any time. The mouth could be opened and closed comfortably.

Alessandri has used the prothesis of Chiavaro with good success after partial resections of the lower jaw.

Rydigier achieved, in 1892, a beautiful result after transplanting into a defect in the lower jaw a skin-pedicled piece of the clavicle which was sewed into the defect.

Bardenheuer and Krause have used pedicled periosteal-bone sections taken from the neighboring part of the lower jaw. Wolfer has used with a negative result a section from the clavicle hanging by a skin-flap, Bardenheuer a skin-periosteal-bone-flap from the forehead. Sykoff transplanted a free section from the neighboring part of the lower jaw. Payr advises the use of a periosteal-covered rib to fill in these defects in one of the two following ways:

1. Osteoplasty by means of a large rib section pedicled by the soft parts of the chest wall. A tongue-shaped flap containing skin and fascia is marked out on the chest, and into the apex of this is placed a section of a rib with periosteum. After two or three weeks the transference is performed, the edges of the soft parts being sutured to the edges of the wound and the ends of the rib-graft to the ends of the fragments of the lower jaw. The advantage of this method is that it can be done in the presence of an opening into the mouth, as a good blood supply will prevent injury to the graft by infection.

2. A second type of osteoplastic lower jaw replacement is by means of a free transplantation of a periosteum-covered rib section. At the first operation the resection is carried out, means being taken to hold the fragments in the proper alignment. At the second operation performed only after the closing of all sinuses, the rib is put in place by dovetailing it into the lower jaw fragments or by the use of metal sutures. For a case of a half resection of the lower jaw the section of the rib should be taken near the spinal column, and should contain the rib head. In cases with defects in the middle of the lower jaw, a median skin-muscle-flap with a section from the manubrium may be taken and inserted directly into the defect at the same time that the resection is made.

Payr in 1908 successfully performed three of these operations, two according to the first method and one according to the second.

McWilliams reports two successful cases of free, autogenous transplantations of sections from the tibia with periosteum into defects in the lower jaw. His conclusions are as follows:

First, the proper alignment of the upper and lower teeth must be maintained by suitable means. In my experience the best being the wiring of the upper to the lower teeth.

Second, no bone-grafting should be done until all the sinuses are perfectly healed, so that no infection remains in the tissues.

Third, all the operative work of grafting must be done from the outside and the mucous membrane of the mouth must not be opened. This is to prevent infection of the graft. If, in making a furrow to lodge the graft and also while freshening the fragments, the mucous membrane of the mouth be accidentally opened, then at that time one should not insert the graft as it would most certainly be acutely infected and die subsequently. The upper and lower teeth should be held in their proper relations, thus preserving the defect intact. The infected wound should be allowed to heal before the graft is inserted. In my experience, if the graft is infected from the mouth at the very beginning, before the circulation has been established in the graft, it will certainly mean the death of the whole graft. (See Case 2.) This is not necessarily true of a more or less sluggish infection which comes on late about a wire suture. In such instances of late infection, there may be necrosis of a small portion of the graft, but it need not necessarily entirely die, if it has a good blood supply. (See Case 1, page 23, Fig. 9.)

Fourth, the graft should always have periosteum on it and it should be taken from the patient himself who is to be grafted, preferably from the tibia. The crest of the tibia should never be taken as a graft, as this so materially weakens the bone that a fracture of the tibia is liable to occur subsequently. This occurred in both my cases. The anteromedial surface of the tibia can safely supply a graft.

Fifth, the graft should not be touched by the gloved hand at any stage of the operation. It should be handled entirely by sterile instruments.

Sixth, the general surgeon should have the help and advice of a skillful dental surgeon in these cases of osteomyelitis and necrosis of the inferior maxilla.

Seventh, the following conclusions were added subsequent to the appearance of the report: In the light of later experience, I would avoid metal sutures altogether, if possible, using chromic or kangaroo-gut, since asepsis in such a location is difficult to attain at the very best and it is consequently wise to avoid implanting any irritating substance. If possible, dovetailing of the graft into the fragment is the best procedure, using gut simply to prevent dislocation. Periosteal sutures alone are not of much use in this location.

Eighth, if because of suppuration the graft dies, the grafting should be repeated, if necessary, a number of times until success is achieved.

In McWilliams' first case (see Fig. 9) there was slight secondary infection of the graft which did not injure its life in the slightest. This infection soon subsided on removing the metal suture. The mouth, during the transplantation, was not opened in this case. On the contrary, in the second case the mouth was opened at the time of the transplantation, although this was not appreciated at the time of the operation, which resulted in the extrusion of the whole graft due to the infection. There are a number of reported instances of failure of the graft to live when grafted into the defect in the jaw when the mouth was opened during the transplantation. Thus, Abadie reports a transplant of a rib in a case of resection of the lower jaw immediately after he had resected a portion of the jaw, the mouth being necessarily opened. The graft extruded itself in two months as a result of suppuration. At the Mayo clinic there was a similar result.

Vorschütz made an immediate transplantation, after resection of the lower jaw for carcinoma, of a section of the tibia with periosteum. The mouth was shut off from the graft by silver wire sutures. Removal of a large sequestrum, which consisted of the entire transplant, was subsequently done on account of persistent suppuration. Case 2 consisted in resection of part of the lower jaw and closure of the edges of the opening in the mouth, followed by immediate transplantation of

bone-graft taken from the tibia with periosteum, and fixation of the ends with silver wire sutures. The wound suppurated violently, and because of persistent high temperature the dead graft was removed. Later reports of these cases showed some thickening as though the bone had been formed from the periosteum which had been left *in situ* after the removal of the grafts. These two cases bear witness to the uselessness of transplanting bone into a defect opening into the mouth. The ultimate results are not stated; but what should be done in such cases is to preserve the width of the defect by maintaining the teeth in proper occlusion by wiring them or by applying a suitable prothesis until the wound is entirely healed and then transplanting. One can transplant as many times as is necessary to secure a living transplant.

Streissler reports another case which illustrates the inadvisability of bone transplantation when the mouth is opened because of operative efforts made to reduce the displaced fragment. The case, a pseudarthrosis 2 cm. back of the mental foramen of the inferior maxilla, was operated on because of difficulty in chewing. In removing the connective tissue, freshening the edges, and replacing the dislocated fragment, the mouth was opened and the edges of the opening sutured. This was followed by the removal of a 4-cm.-long section with periosteum from the under side of the opposite frontal segment which was interposed between the fragments and fastened with silver wire sutures. Two months later the necrotic graft had to be removed because of severe sepsis and profuse suppuration. The patient was fitted with various protheses fairly successfully.

Göbell of Kiel reports two cases in which he transplanted free sections from two ribs with their entire encircling periosteum into defects in the lower jaw. The first case healed by primary union and was an almost perfect success. The second case came down with scarlet fever shortly after the grafting operation and, although the mouth was not opened during the transplantation, the wound suppurated violently, resulting in the extrusion of the graft. He says one may use a fragment from tibia, femur, sternum, and particularly the iliac crest. This last is to be particularly recommended when it is a question of fashioning a new chin, for the crest of the ilium can be fashioned so as to resemble the curves of a normal chin. He makes a great point of taking away with the graft enough periosteum to entirely cover the graft, which, according to McWilliams' cases, is not necessary, half the surface periosteum being all that is requisite. Göbell says when the patient is a young infant, the graft may be taken from the mother or father.

Bardenheuer transplanted into a defect in the lower jaw a metatarsal bone which later had to be removed because of infection.

Esau has succeeded in constructing a fair chin in a case of undeveloped jaw following ankylosis of the temporomandibular joints in childhood. The first step was excision of the articulation and interposition of temporal fascia. Three weeks later he resected 12 cm. of the eighth rib, undermined the soft tissues of the chin, sawed through the mandible in the mental region and inserted the section of rib, which was bent to resemble the chin.

For a successful case of prothesis in a resection of the lower jaw see Heller's[1] report, in which is given the literature on these protheses. The patient cited had worn the prothesis comfortably for two years.

Oppel reports a complex autoplasty to repair a considerable loss of tissue of the face and lower jaw for sarcoma. It was necessary to remove the lower lip, the entire horizontal portion of the inferior maxilla, the submental and submaxillary tissues, the floor of the mouth and a portion of the genioglossus muscle. The saliva ran from the mouth unceasingly, while the patient could neither speak nor nourish himself comfortably. After waiting till after cicatrization was complete, the following grafting was done: From each of the two clavicles, an osteoperiosteal section 6 cm. long comprising half of the thickness of each bone was taken. These two fragments were then implanted under the skin of the middle of the neck, so placed as to make a bony arcade. The grafts succeeded so well that the two contacting internal extremities of the grafts consolidated together. A large cervical flap with convexity below was fashioned, containing the osseous arcade. This flap was lifted up from below and sutured by its lateral borders to the freshened borders of the cheek in such a way that the cutaneous surface formed the floor of the mouth, its free border being rolled around so as to cover the bone-grafts and to form the free border of the lower lip. An attempt was made to cover the raw surface by a Krause cutaneous graft but this became gangrenous. It was necessary to make two flaps in the shape of an epaulette with a superior pedicle, which were united around the neck like a shirt collar. Finally, in order to diminish the dimensions of the buccal orifice, which were too large, it was neces-

[1] Deutsche Ztschr. f. Chir., 1908, xcii, 263.

sary to make a part of the lower lip at the expense of the upper lip and of the cheek. The final result obtained was very satisfactory; the patient can speak clearly but is much troubled by the drooling of saliva.

THE SPINE

Pott's disease of the spine. One of the most successful of all bone-grafting operations is that performed for tuberculosis of the vertebræ. For a further description of this see any good textbook of surgery.

Spina bifida. Albee has reported several successful graftings made for this condition. The operation is very similar to his grafting operation for tuberculosis of the spine.

Trout, in May, 1915, reported making a remarkably successful bone transplant from father to child in a case of spina bifida. The sac was opened, drained, and then closed with a catgut suture and shoved back into the cleft. A bone-graft was taken from the father's tibia and placed over the cleft, where it was anchored with chromic gut sutures passed through the periosteum of the graft, the cartilage of the transverse and spinous processes, and any other firm structure the curved needle would grasp. Four months afterward the growth of the graft was seen to be very extensive and could be readily felt.

CLAVICLE

Witzel reports a successful case of transplantation of the spine of the scapula into a defect made in the clavicle because of the removal of a tumor. An epaulette-shaped incision was made about the shoulder, followed by resection of the outer portion of the clavicle at the junction of its middle and central thirds. The spine of the scapula was separated from the supra- and infraspinati and was chiseled loose with a portion of the body so as to form a relatively broad base. The spine was swung around forward and loosened so much that there was no drag on it and its central end was fastened to the central clavicular end by silver wire sutures. After consolidation the wires were removed because of a small discharge. Seventeen months afterwards, the movements were normal and there was no hindrance in the free use of the shoulder. Consolidation was perfect. The object of this graft, which was to prevent the falling inward of the shoulder, was attained most satisfactorily.

HUMERUS

Duval in a case of subcoracoid dislocation of the head of the humerus resected the head and transplanted into the upper end of the shaft of the humerus the head of the metatarsal bone resected for hallux valgus in the same patient. The long head of the biceps was divided and the metatarsal was sutured to the humeral shaft with catgut. It filled well into the glenoid which was exposed after removing its covering of fibrous tissue. The final result was satisfactory.

Bier removed in 1897 the entire diaphysis of the humerus together with the periosteum for sarcoma. The defect was replaced by a portion of the tibia including both periosteum and marrow. In 1912 X-rays showed that the tibial transplant had developed into a normal shaft with a central medullary cavity.

Braun resected for cysts two-thirds of the humerus with the head of the bone. The defect was filled in by a section from the tibia, with good result. Two years afterward the arm showed no abnormality outwardly. A second similar case also resulted favorably.

Borelius reports two cases in which the upper end of the humerus, including the head, was resected and was replaced by the upper end of the fibula. The functional results were good.

Axhausen successfully replaced the resected head of the humerus by the head of the second metatarsal bone.

Gask resected about half the diaphysis of the humerus for chondrosarcoma and filled the defect with a section of the whole diameter of the patient's fibula, each end being wedged into the corresponding medullary cavity. Seventeen months after the operation the arm was as good as the opposite normal one and X-ray showed that the fibula had increased to the size of the normal humerus.

Bardenheuer in a defect in the humerus made a tongue-shaped flap on the chest, and subperiosteal resection of a rib which was left attached to the flap which was reflected into the defect. There was division of the bridges in two months. Good union resulted.

Huguier has successfully transplanted sections from the fibula into the humerus in three cases. He states that in no case has he ever seen any weakening of the leg because of the removal of the fibula.

Codivilla tells of two successful cases of defects in the humerus filled by sections of the external border of the scapula pedicled by the neighboring muscles.

Stieda transplanted a graft, 14 cm. long, taken from the antero-internal surface of the tibia with periosteum and marrow into a corresponding defect of the upper part of the humerus. A cap

of the head of the humerus was preserved Into this, one end of the graft was implanted and the other end into the medullary cavity of the lower fragment. No foreign substances were used; primary union resulted. Seven months afterward the patient could use the repaired arm as well as the one on the normal side and the graft had increased in size to that of the humerus below.

Brunetti says the fibula is the bone of choice in transplantations. He resected the diaphysis of the humerus for sarcoma and transplanted into the defect a 15-cm.-long graft from the fibula with periosteum. The graft was wedged in the medullary cavities, no bone sutures being used. There followed dislocation of the lower extremity which was replaced in a second operation, at which time the periosteum was found very adherent to the neighboring muscles. The final results were good and the patient had normal movements of the arm. Brunetti believes in taking bone from the individual himself, always with as much non-traumatized periosteum as possible and in the avoidance of any bone sutures.

Streissler reports three successful cases of transplantations from the tibia into defects in the humerus, and one case by a transplant from the fibula.

Stuckey reports the following two cases: In the first case, pseudarthrosis of the middle third of the humerus, a dowel from tibia *without* periosteum was inserted into the medullary cavities. Complete consolidation resulted in 55 days. In the second case, a pseudarthrosis in the lower third of the humerus, a dowel taken from the fibula *without* periosteum was inserted into the medullary cavities. Drainage was instituted and complete consolidation resulted after 45 days.

Davison reports three successful transplantations of sections from the tibia into the humerus.

Hashimoto and So report a case of pseudarthrosis in the right humerus. The fragments were sutured with silver wire, and an osteoperiosteal graft made from the tibia. The consolidation was perfect. They also report a case of pseudarthrosis of the humerus in which an osteoperiosteal tibial graft was inserted and sutured with silk. Profuse suppuration followed; there was no consolidation. They cite two further cases of pseudarthrosis of the humerus in which wire sutures and osteoperiosteal grafts from the tibia were used. In neither case was there perfect consolidation. In another case of a non-union fracture of the humerus, the fragments were sutured, and two osteoperiosteal grafts taken from the two tibiæ. There was no complete consolidation.

Hacker demonstrated by röntgenograms the filling of a defect in the humerus by a tibial graft. After six months the result was so good that the humerus was almost entirely restored and was scarcely to be distinguished from a normal humerus, as the medullary cavity appeared to be restored.

Bier's observations in December, 1912, were based on 16 transplantations of bone. The most striking of these transplantations was the replacement of the entire diaphysis of the humerus resected for sarcoma by a segment of the patient's tibia comprising the anterior half of this bone 26 cm. in length. The operation was performed fifteen years previously and radiograms showed the marvelous result which was obtained. Bier lays great stress upon the influence of the marrow in causing osteogenesis and advises leaving as much as possible of this upon the fragments.

Murphy removed 7.5 inches of the humerus with the epiphyseal line and the upper articular end and transplanted a correspondingly long section of bone from the tibia with its periosteum, the inferior extremity being placed in the medullary canal below while the upper end projected into the joint. The muscles were sutured to the grafts in their anatomical positions. The graft lived, the humerus becoming as large as a normal one and the extremity functionating almost perfectly. Except her inability to raise her arm up close to her head in an extended position, the patient is not reminded that any operation has been performed on her.

Fay resected the diaphysis of the humerus for sarcoma and transplanted into the medullary cavities of the fragments a 15-cm.-long section from the fibula. At the end of seven months union was complete at the upper end of the graft, but a pseudarthrosis existed at the lower end. The patient had perfect use of the limb and could even play the piano.

ULNA

Williamson reports removing an endothelioma from the ulna and filling in the defect with an autoplastic bone-graft. The result was good.

Viannay reports a resection of the ulna for a periosteal osteosarcoma. The defect was immediately filled by a graft comprising only half the thickness of the fibula, which was split longitudinally. The ends were pointed and inserted in the medullary cavities of the fragments, the periosteum being sutured over the points of union. No other fixation was neces-

sary. The result was excellent after 17 months with motions perfect.

Tisserand resected the lower extremity of the ulna leaving the epiphyseal cartilage in place. A 10-cm.-long fragment from the patient's fibula with periosteum on two of its sides was implanted into the defect, being fixed by silver wire. The periosteum on two of its surfaces was left *in situ* in the leg to assure regeneration of the bone of the resected fibula. The result was excellent and the movements of the forearm were restored and the segment of the fibula regenerated.

Janeway resected 16 cm. of the ulna for chondrosarcoma. He transplanted into the defect a graft taken from the crest of the tibia with its periosteum. This graft was sutured by two metal sutures to the remaining extremities of the ulna. The periosteum of the graft was sutured to the periosteum of the ulna, primary union resulting. Fourteen months after the operation the result was beautiful. The graft had become united to the old ulna and was much increased in size. At the time of the transplantation the graft was but 3 mm. in thickness.

Streissler reports two cases of resection defects of the ulna successfully treated by transplanting grafts from the tibia.

RADIUS

Walther reports a case of defect on the lower end of the radius filled by a graft from the superior end of the fibula. The fibular head was applied upon the carpus. There were no osseous sutures but the remains of the articular capsule were sutured to the periosteum of the fibular graft. The result was very satisfactory, the graft reproducing the bone of the lower extremity of the radius and the motions of the wrist being very good.

De Gouvea transplanted the top of the fibula with periosteum into the lower third of the radius for sarcoma. The result was perfect after three months. He says: "The periosteum plays the most important rôle in the preservation of the bone and it is the principal factor in the consolidation of the graft."

Delagénière (de Mans) in a case of ununited fracture of the lower third of the radius, opened the medullary cavity, inserted a nail with the head removed; an osteoperiosteal graft, taken from the tibia, was wound about the fracture (very little bone on graft). Perfect consolidation resulted.

Tietze replaced the lower radius end, resected for sarcoma, by the first phalanx of the great toe whose base was used for the joint surface. The patient was a violin player. Beautiful result.

Neumann transplanted over a year previously the distal 9.5 cm. of the left radius for sarcoma. The defect was filled at the same operation by a piece taken from the front cortex of the tibia. To prevent the atrophy of the free end projecting into the carpal joint and to prevent a nearthrosis the periosteum at the joint end was taken in a right-angled flap which was made large enough to go over and cover the sawed raw end. The graft was implanted without any sutures being used. It has healed perfectly to the upper fragment and the wrist has again attained great movability so that the hand is fully useful.

The technique of choice in dislocation of the head of the radius is not to remove the head but to replace it if it is possible. Ashurst reports a successful case after such a procedure. Likewise, the treatment should be the same in dislocated heads of the humerus and femur, provided the heads are not septic. They should be replaced, even though they be dead but not septic (Murphy).

Piqué has partially resected the inferior extremity of the radius and filled the defect of 5 cm. by making a pivot about the interosseous ligament of a section from the neighboring ulna which he fixed to the radius by inserting the superior radial fragment into the medullary canal of the transplant, while below the union was made by means of a wire. Callus appeared very soon above with consolidation, while below there remained a slight movement. The functional result was perfect.

Lewis reports (Case 11) a compound, comminuted fracture of the radius with a great defect. It is an instance of how patience gained its own reward, for the patient was grafted twice with a final successful result. The first graft from the tibia became absorbed due to a hæmatoma which formed about the graft. It was grafted a second time from the tibia with a successful result.

HAND AND FINGERS (SPINA VENTOSA)

Haas in two cases made partial resections of the diaphyses of two phalanges and transplanted into the defects sections from the tibia with their periosteum. Both grafts lived and functionated well.

Müller in tuberculous osteomyelitis of the phalanges first removed the diseased diaphysis of the phalanx with its periosteum and then transplanted into the defect a piece of ulna which had its periosteum attached. In six out of eight cases the results were good. Even if the trans-

plant were implanted in tuberculous tissue, the graft healed kindly. The fixation was made in the extension.

Thiel reports a case from Bardenheuer's clinic as follows: A girl, aged 12, showed a spina ventosa of the middle phalanx of the right index-finger which did not improve under conservative treatment but progressed to fistula formation. June 9, 1896, under ether anæsthesia, after the application of an Esmarch bandage, an incision was made from the middle of the end phalanx to 1 cm. above the metacarpophalangeal joint. The fistula was excised and the entire diseased phalanx removed; next the tendons were loosened up and the tissues surrounding the head of the first phalanx were cleared away. A wire was inserted through the phalanx near its end, after which a longitudinal piece was cut away from the side, leaving a small bridge of bone in the region of the wire. With the wire as an axis, this piece of bone was then turned over to occupy the gap left by the removal of the middle phalanx. The transplant was anchored to the terminal phalanx by means of a piece of wire. At the end of four weeks ankylosis took place at the first inter-phalangeal joint, but there was motion at the end joint and a good cosmetic result was obtained.

Pels-Leusden says that spina ventosa should be treated by excision of the diaphysis with its periosteum and the defect should be filled in with a graft taken from the tibia with its periosteum. Streissler reports two such successful transplantations.

Leonte made an osteo-articular graft in a case of spina ventosa. He removed the entire metacarpal and replaced it by the fifth metatarsal. Primary union resulted. After a year there was perfect function of the fingers.

Recently another method has been presented which makes use of the substitution of the whole phalanx of the toe for a diseased phalanx of the finger. The first of these cases was reported by Wolff in 1909. His patient was suffering from a spina ventosa of the basal phalanx of the fourth finger, which caused a considerable interference of motion. Under ether narcosis he removed the entire phalanx with some of the diseased tissue. He put in place of the removed phalanx the first phalanx of the second toe of the right foot, sewing it in with catgut. Into the defect of the foot he inserted a piece of cartilage from the sixth rib. At the end of one week he began active and passive motions. He reported a useful joint after a lapse of one year and eight months.

Nikoladoni has replaced a lost thumb by the second toe. The toe is separated from its connection with the metatarsus so widely that it hangs only by a plantar flap of soft parts. It is then fastened to the freshened finger stump by means of bone and tendon sutures. After two weeks the pedicle is divided. The same operator has also replaced a destroyed thumb by forming a thumb out of the tissues of the chest and into this he has transplanted a piece of periosteum-covered bone from the tibia. When this graft was healed in place, he fastened the newly formed thumb, still attached to the chest, to the freshened stump of the old thumb, the bone being rammed into the head of the metacarpal. The pedicle was finally divided, when he was sure that its blood supply was reëstablished, and the thumb was then moulded into its normal shape.

Petroff in a case of tumor of the first metacarpal, resected the entire bone except its head. Into the defect he grafted the first phalanx of the great toe, the distal extremity articulated with the trapezius, the proximal extremity, modeled slightly, was placed in contact with the head of the metacarpal. The result was excellent after three years, the graft becoming in form like that of the metacarpal.

Stubenrauch removed the first phalanx of the left ring-finger for spina ventosa and replaced it by the first phalanx of the second right toe with a corresponding piece of the extensor tendon. The result was excellent.

Goebel resected the last joint of the left small finger of a violinist on account of a deforming inflammation. A free transplantation was made into the defect of the unopened middle joint of the second toe of the left foot. After ten days movements were begun and after nine months the patient was able to appear in a concert. In another case he resected the first phalanx of the ring-finger. He transplanted into this defect the first phalanx of the second toe. He filled up the defect in the toe by a graft taken from the sixth rib. The day after the operation passive movements were begun and on the tenth day active movements were allowed. Some weeks after the operation, motions were as good in the finger as on the healthy side. Radiograms showed both grafts to be perfectly alive.

Sievers resected for sarcoma the entire second phalanx of the left ring-finger, including the two articular surfaces. He transplanted into the defect the first phalanx of the fourth toe, removed entire with its two articular surfaces. He filled in the defect of the toe with a small fragment of the anterior border of the tibia. The result was excellent, and at the end of four months the

Fig. 10.

Fig. 11.

Figs. 10 and 11. Semken's case of a tumor, A, of the third metacarpal bone. Three quarters of the distal portion of the bone were removed and into the defect was transplanted a portion of the tibia, with periosteum. The picture was taken seven weeks after the transplantation and shows that the graft, B, has lived and has consolidated to the stump of the metacarpal bone.

grafted finger could be flexed to 60° and was most useful.

Primrose showed a patient three years after the removal of an enchondroma of the finger. He inserted an ivory splint in the medulla of the bone to maintain position after the shelling out of the enchondroma. An X-ray showed the remains of the ivory peg, much new growth of bone without thickening, and a complete functional success.

Semken (see Figs. 9 and 10) successfully transplanted into a defect caused by the removal for sarcoma of the third metacarpal bone with its periosteum, a section from the tibia with periosteum.

Frazer removed a metacarpal bone and into the defect he transplanted a section of a rib. Müller makes up the loss of a finger phalanx or a metacarpal bone by a graft taken from the ulna.

Schmieden in 13 cases of spina ventosa of the hands and feet has used bone sections taken from the tibia of the patient to fill up the defect caused by the removal of the diseased bones. Good cosmetic and functional results were obtained in 8 cases. The author lays great weight upon thorough removal of the diseased bone with the avoidance of the epiphysis as much as possible. If fistulæ be present, the transplantation should be postponed till they are healed. They should be dressed in extension.

Petraschewska removed the entire fifth metacarpal bone for sarcoma, and replaced the bone with the fifth metatarsal bone, which was sawed off at its base. The joint end (distal end) was placed into the first phalangeal joint and the sawed end was placed against the os hamatum. Primary union resulted. The function of the newly formed joint was identical with the sound joint on the other hand. The defect in the foot caused no disturbance.

FEMUR

Moskowitz resected the lower extremity of the femur for sarcoma and implanted into the defect a section from the fibula. The lower end of the fibula articulated with the articular surface of the tibia. The resultant expansion of the fibula was remarkable. The result was fine. In a second case he filled in an 18-cm.-long femur defect by the fibula from the same extremity. With the help of an apparatus the patient could walk.

Codivilla in a case of subtrochanteric pseudarthrosis of the femur transplanted a part of the iliac crest pedicled by a flap of the gluteus maximus. Consolidation soon resulted.

Davison reports successfully transplanting a section of the fibula without periosteum into the femur for fracture of its neck.

Katzenstein resected 13 cm. of the shaft of the femur for sarcoma. He filled the defect by a section with periosteum from the opposite tibia, the ends of the graft being inserted in the medullary cavities. The result was perfect after nine months.

According to Murphy the head of the luxated femur, or when separated, even though necrotic provided it still be aseptic, should be replaced and fastened in place by a wire nail or by a bone-peg. As Murphy has shown in one case, full regeneration may take place without ankylosis subsequently. When the femur head has become absorbed, it can be reproduced by excising four-fifths of the trochanter with its ligamentous cover and as much of the external margin of the shaft as is necessary to fill the defect left in the neck of the bone. This fragment should be nailed to the freshened neck with the nail head pointing toward the articulation. Murphy prefers a graft taken from the tibia for transplantation into the femur.

Lewis brings out the point that bone-grafts made to fill cavities remaining after curettage of central-giant-celled sarcomata will very frequently die because of the blood-clot which will usually form about the graft, and which will prevent permeation of serum into the bone and also prevent vascularization. He makes the additional point that bone-grafting is usually unnecessary in these cases because the osteogenetic power of the thinned-out cortical bone is great enough to form bone capable of weight-bearing. He cites two cases, illustrating this point, of curettage for sarcoma, one (Case 4) being in the tibia grafted with a section from the same tibia, and the other (Case 5) being in the femur grafted with bone from the tibia. Both formed sinuses and the grafts had to be removed.

D'Arcis resected the upper part of the femur with head and neck for bone-cysts. A transplant was made of a fibula section. The patient walks with a limp after a year. The transplanted fibula has increased to the size of a normal femur.

Delbet in a case of pseudarthrosis of the neck of the femur bored a hole in the neck and in the great trochanter and implanted a fragment of the fibular diaphysis free from periosteum. Perfect consolidation was obtained and radiograms made after the lapse of 10 and 24 months, respectively, showed the transplant still in place and not absorbed. He treated three cases of pseudarthrosis of the femur by fibula grafts.

Stuckey (Case 9), in a case of pseudarthrosis of the femur healed with deformity, used a dowel 7 cm. long with periosteum removed from the right tibia. No consolidation resulted. A second operation was performed consisting in the insertion of a dowel removed from the fibula. Firm consolidation resulted. He also reports (Case 10) a case of pseudarthrosis of the femur. Insertion into intramedullary cavities of a dowel from the fibula without periosteum resulted in complete consolidation.

Lotheissen, in a pseudarthrosis of the femur with great loss of bone tissue, reports the free laying open of the pseudarthrosis by a flap with its base upwards and *outwards*. A bone-flap was fashioned with the base downwards and inwards, the attached femur being split 8 cm. and a corresponding piece, going into the medullary cavity, being separated still attached to the soft parts. By turning 60° the bone-containing flap was inserted into the bone defect and fastened by some periosteal catgut sutures. A plaster splint was applied, and complete consolidation resulted.

Tuffier resected 10 cm. of the right femoral diaphysis for tumor and filled the defect by a graft from the left fibula in such a way that the inferior extremity of the graft penetrated into the supracondylar part of the femur while the superior extremity of the graft was simply approximated to the superior fragment of the femur. After some days it was necessary to make an amputation of the thigh for gangrene of the foot with sepsis. In the amputated extremity the lower femoral fragment was solidly attached to the graft while at the upper extremity the union was so solid that it was impossible to mobilize the graft. All the maneuvers necessary to make the amputation produced no mobility nor dislocation. The grafted surface was covered by normal vascular periosteum and the marrow of the graft bled.

Albee has transplanted the astragalus to make up the loss of the head and neck of the femur. He has also devised a transplantation operation for dislocation of the hip. The great trochanter is sawed off and turned up. The curved superior acetabular bone segment is pried downward and outward with the osteotome to deepen the acetabulum. This leaves a bone gap. The slack in the capsule is reefed by mattress sutures. To fill in the bone gap, a segment of bone having a triangular cross section is removed from the crest of the tibia, long enough when cut into three or more portions to fill in this gutter. The grafts are fixed in position by bone-pegs. The trochanter is returned to its normal position and

sutured with kangaroo tendon through the periosteal structures.

Davison in an article on the "Treatment of Fractures of the Neck of the Femur" concludes:

"1. Autoplastic transplantation of bone is the best treatment for both recent and ununited fractures of the neck of the femur, unless contraindicated by age or condition.

"2. The fibula furnishes the transplant of choice.

"3. The transplant impinging on the points of compact bone, as described, will graft to these points of leverage and give strong support to the line of fracture.

"4. The transplant imbedded in cancellous bone will stimulate the production of osteoblasts and the growth of new semicompact bone in the cancellous area around the transplant, grafting them together by bony union.

"5. The transplant must be completely immobilized until it has grafted to the recipient bone.

"6. The position of immobilization must be extreme abduction and external rotation of the thigh.

"7. The plaster cast to be effective must extend from the axilla to the toes on the injured side and also include the opposite thigh in abduction."

PATELLA

Bone-grafting for fractures. Vulpius reports a case of fractured patella in which the upper fragment comprised three quarters of the bone while the lower was comminuted. He formed a flap from the upper fragment, comprising periosteum and bone, turned this down and fastened it to the beginning of the ligamentum patella. The result was good.

Rogers has likewise made a successful transplantation of bone in a fractured patella.

Habitual dislocation of the patella. Albee reports a method of applying a bone-wedge in habitual dislocation of the patella as follows: A semilunar incision is made extending to the outer side of the patella sufficiently long to reach below the tibial tubercle and above the external condyle. Without unduly disturbing the underlying joint structures, the external condyle is incised with a broad thin osteotome on its external surface, making a bone incision of from 1.5 to 2 inches in length, and about 0.5 to .75 inch below its anterior articulating surface, and nearly in line with the long axis of the femur. The bone incision allows the anterior surface of the external condyle to be raised to a plane above the internal condyle, by producing a greenstick fracture near the intercondylar groove, the object being to place a permanent and rigid obstacle in the way of the outward displacement of the patella. When the anterior segment of the external condyle has been pried forward sufficiently to demonstrate its obstructing effect, the width of the bone-gap thus formed is measured with calipers and a section of bone sufficiently large to fill this cuneiform gap is removed from the crest of the tibia through the lower portion of the same skin wound extended below the tubercle. Before the graft is removed, it is drilled obliquely in one or two places so that it may be pinned to the under portion of the external condyle when put into place. Dowel pins, made from an additional portion of the bone removed from the crest of the tibia at the time the graft is obtained, are rounded to fit the drill holes in the graft.

FIBULA INTO TIBIA

Transplantation of fibula into tibia; Hahn's or Huntington's operation. Hahn first did this operation in 1884 and Huntington in 1905. It is suited to patients in whom there has been an extensive loss of tibia but in whom the fibula remains intact. The procedure is as follows:

Through an appropriate incision (curved, across the leg at the level of the upper fragment) the under surface of the upper fragment is exposed and vivified. The fibula is cut off at this level and its end inserted into the under surface of the tibial upper fragment, where it is fixed. Six months later, a second operation is done; the upper surface of the lower fragment of the tibia is exposed and vivified. The fibula is divided at about the same level and its lower end united to the fresh surface of the tibia. In some cases both operations have been done at one sitting. A graft increases in size according to the demands put upon it. The above transplanted fibula increased in size to that of the tibia.

Stone varied the technique somewhat in 1905. He inserted the upper end of the fibula into a mortise cut in the tibia. Six months later, at a second operation, the outer part of the lower end of the tibia and the lower end of the fibula were exposed through the same incision. The fibula was then split longitudinally for four inches. Great care was taken to avoid separating the periosteum from either end of the bone. At the lower end of the split made in the bone, the inner half was cut across transversely at the level of the upper part of the remaining lower epiphysis of the tibia. The inner half of the fibula was then sprung into its new position in the tibia where it was attached. The result was perfect.

Hamilton in a defect in the tibia transplanted both ends of the fibula at one sitting, splitting longitudinally the lower part of the fibula. This latter procedure would seem to be unnecessary. The whole diameter of the diaphysis of the tibia was lost. At first the upper end of the fibula was cut across and inserted into the tibia. Then the lower end of the fibula was exposed, and cut longitudinally for a distance of 3 inches. "Great care was necessary to split the fibula without fracturing the lower piece. The inner half was sprung over to the lower epiphysis of the tibia, a grooved hole having been cut in the epiphysis to receive it." A year later the boy walked unaided.

Most operators now prefer to take the opposite fibula or tibia and transplant it into the defect, since in this instance they have not injured the leg, in case anything goes wrong with the graft taken from the same side. (See Murphy below as to this point.)

Goldman,[1] resected 30 cm. of the tibial diaphysis for sarcoma, using a modified Hahn's operation. After dividing the fibula immediately below its head, he placed its pointed upper end into a bore-hole made in the upper epiphysis of the divided tibia. Ten weeks afterwards the patient could bear his full weight upon the limb. Two years after the operation, the fibula was as large as the opposite normal fibula.

Lotheissen reports two cases treated by transplanting a skin-periosteo-osseous permanent flap taken from the same bone. The first was a patient with a pseudarthrosis of the tibia. The bone ends were freshened by means of a flap on one side, while upon the other side was formed a flap containing the bone-graft. Its base was below and on the opposite side to the previous flap, and it contained sufficient bone to cover the defect. It was turned about 60° and filled into the defect where it was sutured with catgut stitches. Consolidation resulted.

Tomita reports a case of loss of substance of the right tibia. From the upper part of the same tibia an osteoperiosteal graft was taken and implanted into the medullary cavities of the fragments.

McKenty reports a case with a defect of six inches in the tibia. The ends of the fragments were freshened. "The fibula was then exposed and sawed through at points opposite to the ends of the stumps and the segment about 3 inches long was moved forcibly over into a sulcus prepared for it by a little blunt dissection. One silver wire suture held each end in apposition to the stump of the tibia." Primary union resulted. Three months after the operation he was able to walk on the leg. A röntgenogram shows that the graft has become completely united to the tibia. Both stumps of the ungrafted fibula have also become united to the reconstructed solid shaft of the tibia. McKenty says there is no need of disturbing its covering of soft tissues, and as the transferred segment carries with it the nutrient artery of the fibula, its vitality is not endangered.

MacAusland reported a case in which the whole diaphysis of the tibia was gone, due to osteomyelitis. There was no regeneration of the defect. The leg was flail-like. On November 11, 1909, a socket was drilled in the remaining head and transplanted from its normal position into the epiphysis of the tibia. On December 31, 1900, a similar operation was done on the lower leg, the shaft of the fibula being transplanted as low as possible into the cup-shaped depression made in the lower tibial epiphysis. A plaster bandage was worn for three months. Nine months later the patient could walk and could jump a rope.

Reubentisch[2] reports a case of pseudarthrosis of the right leg. A graft was taken from the superior part of the same tibia, and an osteoperiosteal transplant made which was fixed in the loss of substance by periosteal sutures. Good union resulted.

Transplantations of the fibula into the tibia have been done by the following:

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BABBIO. Arch. di ortop., Milano, 1910, p. 218. (Abstr., Am. J. Orth. Surg., 1911, viii, Feb.
CODIVILLA (2 cases). Cong. ital. chir., 1909.
CODMAN. Ann. Surg., Phila., 1909, June.
FRANCESCO, DE. Clin. chir., 1909, Sept.
GAROVI. Policlin., 1905.
HAHN. Zentralbl. f. Chir., 1884.
HASHIMOTO and So (2 cases). Arch. f. klin. Chir., 1908, vi, 6.
HUNTINGTON. Ann. Surg., Phila., 1905, May. Calif. St. J. Med., 1909, vii, 364.
MCKENTY. Pedicled flap with fibula. Surg., Gynec. & Obst., 1910, xi, 508.
PERRANDO. Arch. de orthop., 1900, Jan.
POIRIER. Deutsche Gesellsch. f. Chir., 1896.
SCHLOSSER. Beitr. z. Klin. Chir., 1899, xxv, 76.
LOEBKS. Deutsche mil.-ärztl. Ztschr., 1907.
STONE. Ann. Surg., Phila., 1907, xlvi.
LEURET (5 cases). Par. Chir., 1911, Feb.
MORRISON. Brit. J. Surg., 1914, 378.
BOND (3 cases). Brit. J. Surg., 1914, 610.
MACAUSLAND and WOOD. Surg., Gynec. & Obst., 1912, xiv, 380.
HAMILTON. J. Am. M. Ass., 1913, 2030.
BRANDES (2 cases). Med. Klin., 1913, 1493.
KAUERT. Beitr. z. XI. klin. Chir., 1912, lxxxii, No. 1.
ROSS. J. Indiana St. M. Ass., 1911, April.
CURTIS. Am. J. M. Sc., 1893, cvi.
GOLDMAN. Lancet, Lond., 1906, Jan. 13, p. 82.

[1] Lancet, Lond., 1906, Jan. 13, p. 82.

[2] Monatschr. f. Unfallheilk., 1903, July.

Lambotte reports a case of pseudarthrosis of the left tibia. An osteoperiosteal free flap from the right tibia was fastened to the freshened sides of the fragments by screws. Consolidation was complete below, slight suppuration above causing delay but finally complete consolidation resulted.

A successful transplantation was made by Kauert of a section of the fibula, permanently pedicled by the soft parts, into a pseudarthrosis of the tibia.

Wittek reports an osteoplasty for pseudarthrosis of the tibia. After freshening the ends, from the anterior border of the same tibia, a fragment 10 cm. long was fashioned which had a large base below while above it was narrow. The superior extremity of this bone dowel was introduced into a cavity made in the tibial epiphysis and the large inferior end was fixed in the notch in the tibia. Primary union resulted, and consolidation was complete on the thirty-seventh day. Five months later a radiograph showed that the bone-peg was still present. Nine months afterwards there was a single bone mass.

Le Jemtel[1] reports a case of pseudarthrosis of both bones of the leg where he made a dowel without periosteum out of one of the fragments and introduced it into the medullary cavity of each of the fragments above and below so that it was solid. Primary union resulted. Consolidation was slow, requiring almost three months, but it was finally perfect so that the patient walked well.

Leuret reports a complicated case of osteomyelitis in which the entire tibia was destroyed, save the upper and lower extremities. He made a high section of the fibula and transplanted it into the upper extremity of the tibia where he fixed it with a bronze suture. There was no consolidation. He operated a second time, destroying the fibrous callous and fixing the fibula anew; consolidation then resulted. It was not necessary to transplant the lower extremity of the fibula. The patient could walk well with an apparatus.

Brentano resected the lower two fifths of the tibia with its periosteum and the lower joint surface for sarcoma, leaving the tendons uninjured *in situ*. A 15-cm.-long defect remained, into which he transplanted a *free* bone-graft with its periosteum of corresponding length. This transplant was taken from the upper portion of the tibia of the same side. The graft was wedged into the defect and rested above upon the tibial resected surface, below upon the tarsus, where a small excavation was made. Sutures above fastened its periosteum to that of the tibia and below to remains of the joint capsule. The ankle-joint in front and behind was drained and the limb put upon a splint. The graft healed *per primam* and after three months consolidation was perfect and the patient could walk with an apparatus.

Stuckey reports a case of pseudarthrosis in the middle third of the tibia of both bones. A 3-cm. defect remained after freshening the ends. From the upper fragment a skin, periosteal, and osseous flap with base below was formed, pushed down and sutured with aluminum-bronze suture. A part of the wound was sutured. A tamponade drain was used and a plaster splint applied. Complete consolidation resulted on the one hundred and fortieth day after the operation. The result was fine.

Bittner resected the entire lower third of the tibial diaphysis leaving the epiphyseal cartilage. All the soft parts were separated from the tibia's outer surface, and the outer half of the tibia was separated with drills, Gigli saw, and chisel, leaving periosteum attached to the inner half. Above, the upper end was at the tuberosity of the tibia. This section was then turned 80° so that the upper broad end came below and was implanted into the epiphyseal cartilage where it was fixed with silk sutures to the periosteum. The original lower part of the segment became now the upper and it was fixed to the lower tibia fragment by a metal suture. The cavity which was left was filled with Mosetig's iodoform plomb. Drainage was inserted behind and below. Consolidation was perfect as was also the result. Röntgenograms showed perfect healing in of the transplanted bone. At first the epiphyseal cartilege did not seem to act, the shortening being 3 cm., but later it took on life and the shortening was only 1.5 cm.

Murphy has the following to say regarding the use of the fibula as a graft into the tibia: "While the fibular transplant from the same leg into the tibia has given a considerable percentage of good results, failure of success is worse than mere failure, as it is disastrous to the limb, and this chance of disaster is entirely unnecessary, as a fragment with its periosteum representing the full length of the tibia from one epiphysis to the other and including the compact bony structure of the tibia can be transplanted from the healthy tibia into the defect of the patient's other tibia without in the least endangering the tibia from which it is removed, and with as great assurance of success as if the fibula were transplanted in the diseased leg." No evil effect has occurred in the tibia

[1] J. de Chir., 1913, Dec., p. 861.

from which the transplant was removed in over 170 cases operated upon by Murphy personally.

Streissler likewise prefers a section from the tibia for grafts, generally in the body, for out of 30 transplantations the tibia was used 22 times as a graft. Of these 30 transplantations, 16 are reported to have had good results.

Lewis offers a valuable suggestion in the use of a form of direct bone transplantation for the correction of vicious deformities associated with Pott's fracture. In his first case the eversion of the foot caused much pain and disturbance of function and the internal malleolus was much hypertrophied. The internal malleolus was divided at the line of fracture and dissected free. The fibula was resected, allowing overcorrection of the everted foot. A transplant was inserted into the fibula defect of a section of the tibia. The malleolus was then trimmed down to the desired size and nailed to the lower end of the tibia, the articular cartilage being preserved. The final result was good. There was no eversion of the foot. The second case was one in which the foot had evidently been dressed in extension, for the patient walked upon the toes and the foot could not be flexed dorsally, due apparently to outward displacement of the internal malleolus, for this part of the bone seemed to impinge upon the astragalus when dorsal flexion was attempted. The internal malleolus was divided at the point of junction with the shaft, dissected free, removed, and preserved in salt solution. The foot could then be brought to a right-angled position and was inverted, and the malleolus was then nailed in place. At the end of four months the patient walked normally and the function of the ankle-joint was almost normal.

The various combinations of methods which can be used in bone-grafting operations are only limited by the ingenuity of the operator. Dyas' instructive Case 3 illustrates this point. A man received compound, comminuted fractures of both bones of both legs. After two months there was no union but considerable displacement of the fragments. Autogenous bone-grafting was done at one sitting on both legs, but by two different methods and by grafts from two different bones. On one side the fractured ends of the bones were brought out through the incision and transversely freshened. A portion of the fractured fibula of the same side, about 3 inches long, was removed and was placed in the medullary cavities of the two fragments. On the opposite side the fibula was not so readily available, so a section was taken from the crest of the tibia, 3 inches long by a third of an inch in diameter, and this was inserted into the medullary cavities. Primary union resulted and perfect consolidation took place within the normal time. Dyas also reports two successful autogenous grafts into fractures of the tibia from the other tibia.

Vulpius states that the treatment of pseudoarthrosis of the tibia has been successful almost without exception, even in apparently hopeless cases, by uniting both fragments by means of a bridgework made of a lamella of bone and periosteum. Technique: A flexible flap of periosteum plus part of the cortical layer of the subjacent bone is cut with a hook-shaped distal extremity, almost parallel to the long axis of the proximal fragment, beginning immediately above the line of fracture. This is done by means of a chisel. Before turning this flap over into the distal fragment, the latter is prepared as follows: Two periosteal lobes are formed; the large one is cut obliquely and folded back laterally; the smaller one is a continuation of the larger one at its lower end, and is folded back distally; into the bone thus denuded of its periosteum a groove is chiseled, corresponding in size and shape to the hook-shaped flap about to be overlapped from the upper fragment of bone; this groove extends to the line of fracture. A similar channel is made in the proximal fragment, extending from the line of fracture to the base of the osteoperiosteal flap described above. The preparation being finished, the osteoperiosteal flap of the upper bone is laid into this channel, bridging over the two fragments of fracture, and is then covered by the peripheral periosteal flaps which are fixed over this newly placed tissue. The limb is then immobilized in plaster of Paris for several weeks. By röntgenograms Vulpius demonstrates the coalescence of the flap with its new bed and its gradual growth *in situ*.

THE FIBULA AS THE GRAFT OF CHOICE

Gangolphe and Bertein maintain that the fibula should be the bone to select and use as a graft for the following reasons: Its solidity since it can support the weight of the body; the fact that its removal, provided the external malleolus be left *in situ*, causes no disturbance in the straightness of the limb nor in the ability of the limb to carry the body weight; its superficial position which renders the removal of the graft easy; a very great advantage is the possibility of obtaining a bone fragment completely surrounded by periosteum, this membrane being so important to the life of the graft. The side from which one takes the graft, provided the upper extremity is to be grafted, is different. If, how-

ever, it is to be transplanted into the lower extremity, Gangolphe and Bertein, contrary to Hahn and Huntington, remove the fibula on the side opposite to the bone to be grafted. One removes the entire thickness of the fibula. It is useless and most difficult to longitudinally divide the bone, as Viannay does, or to preserve a band of periosteum as Tesserand does.

As for the technique the transplantation is made at the same sitting as the resection. It is best to wedge the pointed extremities of the fibula into the medullary canals of the ends of the resected bone. When this is impossible because of the narrowness of the medullary canals, as in the forearm, the graft should be fixed by buried metal sutures. One should never drain. In 11 instances the graft was transplanted into the upper extremity. In every case, that is in 7, in which there was no recurrence of the tumor, the limb was solid and the function was perfect. In the lower limb of 9 cases, 5 of which were made into the femur, the limb has become solid and useful in 6 instances. In prolonged osteomyelitis with great sequestra it has given a score of successes.

Nové-Josserand reports a case of congenital absence of the inferior part of the tibia in which he successfully transplanted the fibula.

Barbet says that of 27 cases of pseudarthrosis in which the fibula was transplanted, only 2 were unsuccessful. These were transplanted by Hashimoto and Schlosser.

See page 36 for bibliography of authors who have transplanted the fibula into the tibia.

Lenormant likewise makes a strong plea for the use of the fibula as a transplant.

FOOT

Frattin has used an osteoperiosteal fragment taken from the fibula to fix a paralytic flail-foot by fixing the graft upon the external malleolus and the calcaneus.

In Albee's method for the correction of paralytic club-foot, the graft is placed between the astragalus and the scaphoid; in congenital club-foot, the scaphoid bone is split transversely in halves, and a small piece of bone from the tibia or from the cuboid is inserted between these halves. Albee believes these operations are often permanently correct, and that the awkward flail condition is often overcome and the foot lengthened. He has performed 14 of these operations.

Soule reports a method of applying a bone-wedge in the treatment of club-foot: The joint surfaces having been exposed from above, the articular cartilages on the astralagus and scaphoid are removed. Next, triangular segments of bone are removed from the head of the astralagus and from the corresponding opposite surface of the scaphoid to admit a wedge-shaped segment of bone secured from the antero-internal surface of the tibia, and after forcing the foot into its corrected position the graft is slid into position from above downward. The forefoot then released fixes the graft securely in position without sutures. Albee has performed 16 wedge-graft corrections of congenital club-foot.

Streissler resected four metatarsals, the cuboid and two cuneiforms. They were replaced by three strips from the tibia.

THE FUTURE OF THE EPIPHYSIS WHEN TRANSPLANTED

What the future of the epiphysis when transplanted will be, cannot as yet be accurately or positively stated. Not enough work has been done upon it as yet to determine whether the epiphysis will survive and functionate if it be transplanted or whether it will die. Jost[1] goes into this unsettled question so far as it can at this time be discussed from the few data at hand.

THE TRANSPLANTATION OF JOINTS

In very rare instances the after-results of joint transplantations have been fair. Friedrich remarks that the number of poor results following joint transplantations has been "frightful (*erschreckend*)." In the vast majority of cases, the result has been the same as though a typical resection had been performed; i.e., ankylosis. Space forbids a further discussion of this topic.

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ABSTRACTS OF CURRENT LITERATURE

GENERAL SURGERY

SURGICAL TECHNIQUE

ANÆSTHETICS

Watt, C. H.: Intratracheal Ether Anæsthesia in the Surgery of the Brain and Spinal Cord. *J. Am. M. Ass.*, 1915, lxv, 869.

This article is based on a review of 70 neurologic cases from Johns Hopkins Hospital. In 35 of these the intratracheal method of ether anæsthesia was used and for the remaining 35 the drop ether method was employed.

The importance of having a quiet, uniform anæsthesia in this branch of surgery is dwelt upon. Of the embarrassment incident to obstructed respiration and cyanosis, to coughing and straining during operation, the operator and anæsthetist have been entirely relieved by the use of intratracheal ether anæsthesia.

The distinguishing features of this method, as pointed out by Meltzer, are set forth, together with other advantages brought out by a study of the anæsthesia charts in these 70 cases. These charts were studied with reference to pulse, time consumed, cyanosis, hæmorrhage, time required to regain consciousness, and post-operative complications. With these points in view, comparison of the two methods shows decided advantage in favor of the intratracheal method in most instances. The most striking difference is in the pulse tracings. For the total cases the pulse-rate averages 20 beats, more under drop ether than under the intratracheal ether, and in the cerebellar 52. This is graphically shown by charts.

One striking case is reported in detail. This case had had three operations performed under general anæsthesia—drop ether and chloroform—and each time the operation was abandoned because of the anæsthesia. At a later operation the intratracheal method was used with pronounced success.

In comparing this method with other types of anæsthesia, that is, local and intrapharyngeal, the author believes that the intratracheal method possesses all the advantages of the local without sharing its disadvantages, and that there are no essential differences between the intratracheal and the intrapharyngeal methods.

A few points in connection with the technique are brought out: (1) Complete anæsthetization of the patient before attempting to introduce the tube. (2) Care should be used in introducing the catheter lest the vocal cords be injured. 3. It is necessary to make certain that the tube is in the trachea and not in the œsophagus before driving in the ether vapor.

The conclusions are:

1. Intratracheal ether anæsthesia has its greatest field of usefulness in operations on the head, neck, and spinal region. The results in cerebellar cases are the most striking.

2. This method is much safer than the drop ether method; the anæsthesia is smoother and more readily controlled. It also offers the most efficient means of artificial respiration.

3. A review of 35 cases of anæsthesia by the drop ether method and 35 by the intratracheal method shows that the pulse is more regular and less rapid under the latter and that hæmorrhage and cyanosis are reduced to a minimum.

Keyser, J. S.: Morphine, Limitations and Uses as an Aid to Anæsthesia. *Delaware St. M. J.*, 1915, v, 1.

The author begins his article with the statement that the use of morphine, morphine and atropine, morphine and scopolamine or hyoscine as an aid to induction of anæsthesia has both indications and contra-indications. However, the contra-indications are so many that his aim is to emphasize them, even in the face of the very general use of these preliminary drugs. The use of morphine, with or without the other drugs, became popular from the theory that they were anæsthetics and synergistic with ether or chloroform. On the contrary, they have action of their own and, though narcotic, hinder rather than help the anæsthesia. Indeed he finds induction is shorter without than with the preliminary drugging.

Urine examination also reveals renal irritation or inflammation, the degree, of course, depending upon the quantity and kind of anæsthetic, duration of administration, and previous health of the patient. Morphine, sufficient to tranquilize the patient, must check the urinary output and hence be objectionable. The action of morphine also upon the pupil and its light reflex is objectionable, and the retarding of the respiration is a decided embarrassment to the patient, diminishing oxygenation just when it is particularly needed. Morphine may be

indicated in muscular male patients to check secretion of mucus, and in women of a neurotic type, also with nitrous oxide and oxygen, this anæsthesia putting no extra tax of secretion upon the kidneys. FRANK W. PINNEO.

Weber, E.: Means of Preventing the Injurious Action of Anæsthetics on the Central Nervous System (Die schädigende Wirkung von Operationen in Narkose und Lokalanästhesie auf das Centralnervensystem und ihre Beiseitigung). *Med. Klin.*, Berl., 1915, xi, 991.

In previous articles the author has reported experiments that he has been making for years with reference to the central mechanism for the innervation of the blood-vessels. The war has furnished him added facilities for the prosecution of such research.

To test the function of the nerves controlling the blood-vessels he lets the foot hang free and exercises it by dorsal and plantar flexion. In health and when the patient is not exhausted, this gentle exercise induces dilatation of the blood-vessels, except in the brain. When the body is very much exhausted, or when there has been concussion of the brain, this effect is reversed and the blood-vessels contract.

After local anæsthesia there is not only this reversed vasomotor action, but the whole vessel tonus is changed, the change being manifested by severe and long-continued dilatation or atony of the vessels. This disturbance lasts for two or three days after local anæsthesia. After chloroform anæsthesia it is much more pronounced and long-continued. The morbid vascular reaction was sometimes manifest from one to six weeks after operation. These phenomena are explained by the fact that the central vasomotor mechanism is extremely sensitive to injurious influences brought to it by the blood. This mechanism, however, seems to be restored to normal by the stimulating action of alternate hot and cold douches.

Weber reports fifty cases studied from the above point of view. All of them had been examined and found to have normal vasomotor reactions before the anæsthetics were given. Tracings from two cases are given. One of the cases showed abnormal vasomotor reactions four weeks after chloroform anæsthesia. The alternating hot and cold douches were then applied and soon all the symptoms had disappeared. These symptoms were muscular weakness, exhaustion on climbing stairs, profuse sweating after slight exertion, and headache—all of which resulted from the disturbance of the central mechanism for the innervation of the vessels. The injurious effect of ether seemed to stand about midway between that exerted by chloroform and by local anæsthesia. A. Goss.

SURGERY OF THE HEAD AND NECK

HEAD

Cole, H. P.: Harelip Surgery; Essentials in the Production of Scarless Incisions. *South. M. J.*, 1915, viii, 700.

Cole believes the following factors tend to prevent scars following operations on labial defects:

1. The use of adhesive strips to obtain relaxation before operation and careful cleansing of the mouth and nose before operation to reduce the amount of infective material.

2. Incisions in the red mucous border should be made at an acute angle to the white skin line, and end in a teat-like projection at the center of the lip. Thin, sharp instruments are to be used.

3. The tissues are relaxed by freeing them well out onto the cheek; this is done with blunt dissectors and curved scissors. Lead plates and silver wire are used to hold the septum over, after it is freed.

4. Horse-hair is the preferred suture material, and the skin sutures are removed at the end of twenty-four hours, the latter point being emphasized.

Guleke: Treatment and Prognosis of Gunshot Injuries of the Skull (Über Therapie und Prognose der Schädelschüsse). *München. med. Wchnschr.*, 1915, lxii, 989.

Guleke has treated a large number of gunshot injuries of the skull. Of 12 cases in which the shots passed entirely through the skull, 2 died; they were not operated on, on account of coma in one case and meningitis in the other. In such injuries great care must be taken to see that the wound canal does not become infected secondarily. This takes place particularly easily in wounds where brain substance comes out of the opening in the bone and collects under the soft parts. In such cases Guleke cuts away the soft parts until he comes to healthy bone; he then removes the brain substance and sponges the wound dry. After that, the wound quickly becomes covered over with clean granulations, and heals.

There were 26 cases in which the bullet had lodged in the brain. Of these 3 died: 1 that could not be operated on because of meningitis, and 2 died six weeks after operation from brain abscess. He operates and removes bone fragments and the projectile if it can be localized by röntgen rays and is easily accessible. A search for the projectile should not be made through an entrance wound that is infected or may easily become so. If there is already infection and retention the skull should be freely opened; if there are epileptiform attacks from rapidly increasing brain œdema or irritation of the meninges, operation should be immediately performed.

Among 103 patients with tangential injuries, 75 had open injuries of the brain, and 35 of these died: 27 from meningitis, 5 from progressive encepha-

litis and ⅓ died from the severity of the brain injury.

The fact that the dura is intact does not guarantee that there will not be a septic process in brain injuries lying underneath it. One case died six weeks after a primary operation on the bone from brain abscess. In 60 of the cases of tangential shots the bone was not injured, but in all cases where it was, Guleke operated immediately; and even in cases where apparently only the soft parts are injured, he makes a röntgen examination, for it sometimes reveals fracture of the internal table. In the treatment of these wounds, if the defect in the bone is not too great, the author does no suturing but simply drains with a rubber tube and loosely tampons the wound. He has found that brain abscess appears four times as frequently in the cases that are not operated upon as in those that are operated upon promptly; but at least 15 per cent of the cases of tangential wounds die later of brain abscess, even when they are operated upon. Other complications are also apt to appear later, as cortical epilepsy, color blindness and other disturbance of vision, so that the case cannot be regarded as closed for years. Openings in the skull should be closed after about six months by plastic operations. A. Goss.

Löfberg, O.: Covering Defects in the Skull (Zur Deckung von Kranialdefekten). Militaerarzt, 1915, xlix, 274.

Löfberg describes four cases in which gaps remained in the skull after trauma. In one case a piece of the internal table that had been broken off was inserted into the gap. Two were covered over simply with flaps of skin and periosteum, while the fourth was covered with a piece of bone removed from the patient's tibia. Recovery was uneventful.

For a long time there was considerable discussion as to whether such defects should be covered over at all, but surgeons are now generally agreed that they should be, for the sake of freeing the patient from the dangers to which he is subjected by having his brain exposed, and because the bone of the skull shows little tendency to regeneration. Various materials have been suggested for the purpose. Various kinds of metal plates have been used, as well as cooked bone from other animals, and the horns of cows, which have been used very successfully in Lexer's clinic. Löfberg believes that it is preferable to use bone from the patient himself, because the transplant takes better and does not behave as a foreign body, as other substances frequently do. A layer of bone may be taken from the external table and inserted into the gap, or quite large pieces of bone can be obtained from the tibia for the purpose. He does not think it advisable to use bone from the scapula.

Kleinschmidt proposes taking the bone from the median surface of the tibia and leaving the periosteum twice as long as the bone, so that it may be folded over, and the bone thus be covered on both sides with periosteum. A. Goss.

Marburg, O. and Ranzi, E.: Late Abscess After Gunshot Injury of the Brain (Über Spätabszesse nach Schussverletz ungen des Gehirns). *Neurol. Zentralbl.*, 1915, xxxiv, 546.

The authors have operated upon 62 cases of gunshot injury of the brain during the past year, with 23 deaths. Among these 62 cases abscess was found at operation in 42. But there were a number of patients who apparently recovered perfectly from the operation, but who later developed abscesses and died. Six such cases are described. The abscesses generally developed four or five months after the operation; in one case the interval was eight months.

The symptomatology of late abscess is quite characteristic. The patient shows a rise of temperature for awhile, and then suddenly general symptoms develop, such as headache, vomiting, and signs of beginning meningitis. There is apt to be an increase in already existing local symptoms, such as hemiplegia or aphasia. These phenomena are explained by the fact that the abscess has been strictly encapsulated for some time, but finally there has been propagation of the pus to the meninges through a small opening into one of the ventricles. Often when the abscess becomes manifest it is too late to save the patient by operation, but cases can often be saved by early operation. An illustrative case is described.

From the foregoing it is evident that all cases of brain or skull wounds should be kept under careful observation for several months, and if there is a rise of temperature or the slightest sign of cerebral irritation the wound should be opened up. If there is pus, free incision and drainage are indicated. A. Goss.

Mayer, O.: Plastic Covering of Defects of the Dura After the Excision of Brain Prolapse (Über die plastische Deckung von Duradefekten nach Abtragung von Hirnprolapsen in der Otochirurgie). *Ztschr. f. Ohrenh. u. f. d. Krankh. d. Luftwege*, 1915, lxxiii, 37.

Mayer advises a more active treatment than do most surgeons for persistent prolapse of the brain. He does not think it necessary to wait until the prolapse has healed over to be sure of asepsis, but advises operation in every case because of the dangers to which patients with persistent prolapse are exposed. After removing the prolapse, the defect, not only in the bone, but in the dura, should be closed by a plastic operation. He has done this successfully in one case by using a flap of periosteum. The flap of periosteum quickly becomes adherent to the dura and puts a stop to the discharge of cerebrospinal fluid, thus reducing to a minimum the danger of secondary infection of the meninges. There need be no fear that a rise of intracranial pressure will sever the union between the periosteum and dura. This plastic closure of the dura also prevents the formation of a scar adherent to the skin and extending into the brain. The advantages

of this plastic operation are so great that the author advises it even in cases where the prolapse has receded spontaneously, for there may be a scar of the dura mater that will become adherent to the brain and produce serious disturbances. A. Goss.

NECK

Eastman, J. R.: Permanent Partial Compression of Both Common Carotids in Epilepsy. *Am. J. M. Sc.*, 1915, cl, 365.

The author bases his experiments on the theory that the amount of blood in the brain has some relation to the epileptic attacks. Von Reimer, Corning, and Momburg, prior to this had good success in controlling the convulsions by digital compression of both carotids. The latter sought to make the relief permanent by twisting a one millimeter silver wire around each common carotid until the temporal pulse was barely perceptible and after two months he reports distinct improvement in his two cases. The same technique was used by the author in 6 additional patients. While but a few weeks have elapsed in some cases, all show more or less improvement except one which developed coma immediately and necessitated the removal of the silver wires.

Eastman concludes that future experimentation is not without danger and is only justifiable in general idiopathic epilepsy in youthful persons or in traumatic or focal epilepsy which has resisted cranial decompression or other appropriate treatment; also that the sudden influx of blood into the brain is not the real cause of epilepsy but may determine the frequency and severity of the attacks. Henry J. Van den Berg.

SURGERY OF THE CHEST

CHEST WALL AND BREAST

Willis, B. C.: A Plea for the Reduction of the Death Rate from Cancer of the Breast. *Old Dominion J.*, 1915, xxi, 103.

When women are sure that there will be no guessing as to the nature of the growth and no mutilating operation undertaken not commensurate with the gravity of the disease, they will come early for treatment. They dread the lump in their breasts but still more the mutilating operation without a positive diagnosis of cancer. Consent to the removal of a small tumor, not of the breast, can usually be obtained readily before symptoms are manifest. If a positive clinical diagnosis can be made from subjective and objective symptoms, the favorable operative cure of about 75 per cent will be reversed.

It has been the author's practice in small tumor cases to remove them under local anæsthetic, make a positive diagnosis, and proceed accordingly. Until a cure for cancer is found, physicians must depend for any increase in permanently cured cases on early surgical interference, for the utmost limits of radical operations upon the breasts and glands involved have been reached. The consensus of opinion is that cancer is on the increase, which is undoubtedly true. This increase may be discounted by two factors: first, more women reach the cancer age; second, lack of exercise of the breast functions. Edward L. Cornell.

Dayton, H.: Diagnosis of Intrathoracic Neoplasms by Exploratory Puncture. *Surg., Gynec. & Obst.*, 1915, xxi, 304.

Dayton reports a case demonstrating the diagnostic value of examination of the tiny fragment of tissue obtained by exploratory puncture with an aspirating needle of moderate size in cases of intrathoracic lesions of doubtful character.

The history was that of a case of serofibrinous pleurisy, but the convex upper level of the radiographic shadow in the chest and semitransparent areas within it; blood-tinged pleural fluid; the displacement of the heart toward the left; the presence of a tympanitic area between the area of cardiac dullness and one of dullness in the right chest anteriorly, with a friction rub over the area of dullness; persistent eosinophilia in the absence of intestinal parasites or other obvious causes, and irregularity of the areas of nasal voice—all suggested the existence of a neoplasm rather than a serofibrinous pleurisy. A needle inserted into the right chest in the ninth space near the angle of the scapula in order to obtain a fragment of tissue for examination, yielded blood-tinged serous fluid in which were two small fragments which resembled thick mucus enclosing shreds of tissue about 1 mm. in diameter and 1.5 mm. in length. These showed a typical angiosarcoma.

Encouraged by his success in diagnosing this case, the author has attempted the same unsuccessfully in two others. He says that examination of fragments of tissue obtained by exploratory puncture, employing a needle with a lumen of about 1 mm., is of diagnostic value only when the results are positive; but in these instances it may be of real assistance in differentiating from syphilis, tuberculosis, and delayed resolution of pneumonia.

TRACHEA AND LUNGS

Chiari, O.: Circular Resection and Suture of the Trachea and Plastic Reconstruction of Large Defects in the Trachea (Über die zirkuläe Resektion und Naht der Trachea und die plastische Rekonstruktion grösserer Defekte der Trachea). *Monatschr. f. Ohrenh.*, 1915, xlix, 337.

Circular resection and suture of the trachea has been practiced since about 1880, but Küster in 1885

was the first to report a plastic operation to repair a defect that was so large that the two ends of the trachea could not be brought together. Chiari gives the histories of 16 similar cases since reported.

The trachea may be resected for trauma, stenosis from diphtheria, or for new-growths. Care must be taken in making the resection to spare the recurrent laryngeal nerves. When it is a question of merely suturing the ends of the trachea together, the head is bent forward and the posterior part of the trachea sutured with catgut from inside, and then the anterior wall sutured from outside with silk. The soft parts are then sutured in several layers and a small drainage opening left. If it is necessary to do a plastic operation, Chiari prefers Gluck's technique. He takes a quadrangular flap of skin from the right side and sutures it in position to form the posterior wall of the trachea. This is then left to heal, and at a second operation a flap from the left side, still attached by its base to the neck, is sutured in position to form the anterior wall, with the epidermis inside. Then another flap of skin from the sternum, including a thin layer of bone, is placed over this, so that the anterior wall is reinforced with bone.

In a case of the author's it was only necessary to resect half of the wall of the trachea, so that the lumen was easily restored by means of a skin-flap. He advises leaving a part of the wall of the trachea if possible, because if the whole wall is removed, the traction of the weight of the lungs may be sufficient to obliterate the lumen and bring about a recurrence of the stenosis. But if it is necessary to resect the whole circumference of the wall, Gluck's two-stage plastic operation is very much preferable to simple circular suture. A. Goss.

Friedberg, S. A.: Foreign Bodies in the Respiratory Tract. *Illinois M. J.*, 1915, xxviii, 175.

The author gives his personal experience of some of the phases of the symptomatology, diagnosis, and treatment of this condition. The difficulty at times in obtaining a satisfactory or definite history of an accident is discussed. The presence of a foreign body in the œsophagus may produce respiratory distress thus simulating the symptoms of a foreign body in the air passages. A case in point is detailed. Signs and symptoms produced by the lodgment of a foregin body in the larynx, trachea, and various parts of the bronchial tree are given with illustrative cases. Emphasis is laid on the localization of physical findings in certain parts of the lungs. Among these are localized bronchitis, pneumonia, bronchiectasis, or abscess. Röntgenoscopic examination with its value and limitations is considered, and changes produced in the lung by the long continued presence of a foreign body are described.

The progress of the patient after removal and the necessity for further observation and treatment is strongly emphasized. Bronchoscopic treatment with caution as to technique, anæsthesia, the indications for upper or lower bronchoscopy, complications and difficulties and röntgenoscopic bronchoscopy are briefly discussed. Anæsthesia, other than local in adults, is not recommended. Children are easily handled without any anæsthesia.

Upper bronchoscopy should be done wherever possible unless a tracheotomy, as an immediate life saving procedure, is necessary. Infancy is no bar, as was formerly taught by the Killian school, to upper bronchoscopy. The author's youngest patient in which a foreign body was removed by the upper route was three months of age.

Marion, G.: Extraction of Projectiles from the Lungs (De l'extraction des projectiles intra-pulmonaires). *Presse méd.*, 1915, xxiii, 353.

Marion thinks that foreign bodies should be removed from the lungs in all cases. It is a simple and harmless procedure and not attended by the danger which most surgeons have been inclined to attribute to it. A projectile in the lung is a source of constant irritation and exposes the patient to attacks of pneumonia, and it also prevents them from returning to military service. He has seen patients who did not complain of any objective symptoms, but only of interference with respiration, and when he removed the projectile he found it surrounded by an encysted abscess.

He localizes the projectile with a localizing compass and makes an incision over it. If it is under a rib, 4 or 5 cm. of the rib is resected. The lung is then fixed to the thoracic wall with three or four catgut sutures, so that the field of operation is held firmly. In only one case did he fail to find the bullet and that was one in which he failed to fix the lung to the thoracic wall in this way. The lung is then incised and the bullet removed with the finger. It is much easier to detect a bullet in lung tissue than in muscle. A tampon wet with strong carbolic acid is placed in the wound and the usual dressing over it. He describes 27 cases in which he has removed projectiles in this way and recovery was rapid and uneventful in all cases. A. Goss.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Quénu, E.: Injuries of the Abdomen (Plaies de l'abdomen). *Bull. et Mém. Soc. de chir. de Par.*, 1915, xli, 1815.

Quénu presented to the surgical society the abdominal cases of Petit, Charrier, Bichat, Pascalis, Pellot, Bouvier, and Caudrelier. His report includes 153 cases, 110 of which were operated upon, 103 of them being primary laparotomies.

In the first part of the work he gives reports of the individual cases of these different surgeons, followed by a table, giving the nature of the wound

in all the cases, the operation, and results. In the second part he discusses in a general way the treatment of injuries of the abdomen in war.

Eliminating the non-penetrating wounds from the 103 cases mentioned above, there remain 96 penetrating injuries of the abdomen treated by primary laparotomy with 53 deaths, or 55 per cent. In a series of cases previously reported by him and given conservative treatment there was a mortality of 67 per cent, but even this he thinks was too low, for a considerable number of the cases reported from the field as penetrating wounds are found on closer examination to be non-penetrating.

The author thinks that operation should be performed in all cases that are clearly penetrating, and if there is doubt an exploratory operation is justified. Needless to say, operation should be performed as soon as possible; but if the hospital is placed too close to the firing line it is not only in constant danger, but it cannot be as well equipped as one farther away. The best arrangement seems to be a hospital 15 or 20 kilometers from the firing line with a well-equipped automobile ambulance service from the front.

As to the technique, skill and thorough sterilization are of course prerequisites. The anæsthetic used in most of the cases reported was chloroform. Spinal anæsthesia has been found unsatisfactory. The incision was generally either through the entrance and exit wounds, or a median incision above or below the umbilicus, as indicated. In injuries of the small intestine, suture or resection and suture was generally practiced. Perforations in the large intestine were sutured, but circular suture of the large intestine is much more dangerous and less effective than that of the small intestine. Injuries of the liver were generally tamponed, but if small were occasionally sutured. Injuries of the spleen were generally treated by splenectomy. Some of the wounds were drained and some were not, but Quénu is inclined to favor systematic drainage through the pelvis. The question of the best time for evacuation of cases of abdominal injury is not yet settled. A. Goss.

Jung, E.: Lavage of the Peritoneum with Ether (Il lavaggio del peritoneo con l'etere Solforico). *Clin. chir.*, 1915, xxiii, No. 4.

To test the ether treatment of acute peritonitis recommended by Morestin, the author carried out a series of animal experiments in which he irrigated normal and inflamed peritoneums with ether. He draws a distinction between the immediate and late effects. The immediate consequences are local and general in nature. Locally the rapid evaporation of the ether produces a temporary constriction of the mesenteric vessels, which later dilate, causing a rapid and quite marked fall in temperature in the abdominal cavity, which produces a certain degree of shock. The loops of intestine redden and show spasm of the muscles.

The general symptoms are caused by rapid absorption of the ether, which in itself may cause death. The absorptive capacity of the inflamed peritoneum is decreased, so that the general symptoms are not so intense in purulent peritonitis, but absorption is favored by the pressure under which the ether vapor is placed in the abdominal cavity. The bactericidal effect of the ether does not take place because of its rapid evaporation. The late effects are serous-hæmorrhagic inflammation of the peritoneum followed by adhesions; there were changes in the kidneys only in exceptional cases. The experiments did not show any therapeutic effect in peritonitis in dogs; in rabbits death was undoubtedly hastened. In septic peritonitis in dogs death seemed to have been delayed somewhat. The author concludes that Morestin's method is entirely too dangerous to be put into practice. A. Goss.

GASTRO-INTESTINAL TRACT

Nyström, G.: Drainage of the Stomach by Gastrostomy (Über Magendrainage durch Gastrostomie). *Zentralbl. f. Chir.*, 1915, xlii, 721.

Jaboulay first proposed draining the stomach by gastrostomy in cases of ileus. He published a case in 1905. Lennander in the same year reported his use of gastrostomy for the purpose of drainage in volvulus of the small intestine. He extended the indications for the operation considerably, but his recommendations have not been generally adopted.

Nyström recommends the procedure in the following conditions:

1. In ileus. Drainage of the stomach empties out the intestinal contents from the stomach, avoids distension, allows free movement of the diaphragm and prevents interference with heart action and respiration.

2. In operations on the stomach where there is any danger of the sutures not holding, especially after operations for perforating ulcer of the stomach or duodenum. It serves the double purpose of removing toxic intestinal contents from the stomach and preventing distention and pressure on the sutures from within. The patient is relieved of vomiting, pain, and restlessness. The stomach fistula also allows of examination of the stomach contents at different phases of digestion, and of regulation of the diet based on the findings.

The author describes the very simple technique of performing the gastrostomy by means of a cannula containing a catheter. The walls of the abdomen and stomach are punctured with the cannula and it is withdrawn, leaving the catheter in place, where it is fastened with a purse-string suture and left for about a week. A. Goss.

Torrance, G.: Rovsing's Operation for Gastrocoloptosis, with a Report of Seventeen Cases Successfully Operated Upon. *Tr. Am. Ass. Obst. & Gynec.*, Pittsburgh, 1915, Sept.

The 17 cases cited have been operated upon within the past two years. The symptoms which were

the most prominent were constipation, epigastric pain (usually left-sided), nausea, and vomiting, a toxic condition evidenced by headaches, nervousness, cachexia, loss of weight and marked mental depression in some.

All but 2 cases were fluoroscoped and X-rayed. Six cases had been previously operated upon without any relief of the symptoms; in 5 the appendix had been removed; in 1 case pus-tubes had been removed; and in 1 case the left kidney had been removed for severe left-sided pain.

With this method the appendix is removed and all other intra-abdominal conditions that need it are attended to, as uterine retroversion, cystic ovaries, etc. In one case the gall-bladder was drained.

Rovsing's operation has been modified somewhat, and an operation has been devised for the elevation of the liver by thrusting a curved forceps through the posterior fascia just at the tip of the ensiform cartilage; the suspensory ligament is caught and pulled back through this opening and drawn down tight enough to bring the liver up snugly against the diaphragm, the ligament being then sutured to the fascia.

The usual three rows of sutures are passed on the anterior surface of the stomach and the colon is sutured to the lower part of the anterior surface of the stomach by strong interrupted linen sutures, using the lower band of the colon, and by holding the omentum up and using a straight needle, the sutures are passed through the omentum near the attachment to the stomach; by this method the omentum is not puckered up as in Rovsing's operation and not attached to the abdominal wall as in Coffee's operation, but remains intact and as free as before operation. The colon is elevated considerably more than by the other methods and leaves no cavities in which the small gut may become strangulated.

The first case, a female, 19 years of age, had been troubled with constipation, loss of weight, toxæmia, and fever. Appendectomy was performed two years ago, Rovsing's operation being used, and the cæcum pleated over. The patient has gained 30 pounds, her color is normal, and the constipation and all toxic symptoms are cured.

The second case, a male 30 years of age, had marked constipation, and had been given croton oil in order to get a movement. He was very toxic; was bed-ridden, and his temperature would run up to 105° F. at times. Appendectomy was performed. He gained 30 pounds in four months; he has been relieved of all toxic symptoms and is back at his regular work.

The third case, a male aged 34, a city detective, was so troubled with constipation, left-sided pain, and severe headaches, that he was practically obliged to give up his work. He was relieved of the constipation, headaches, and all other symptoms, and 16 months after operation is hard at work chasing train wreckers. A skiagram recently made with bismuth meal and enema shows the stomach and colon in normal position.

The second case, a female aged 33, had not been well since puberty, was constipated and toxic; was troubled with backache, digestive disturbance, and nervousness. Rovsing's operation was done 18 months ago. She is completely relieved of the constipation and nervousness and says she is perfectly well.

The fifth case, a female 50 years of age, had not been well for ten years; was troubled with nausea and vomiting; constipation not marked. Rovsing's operation was done 15 months ago, and the gall-bladder was drained at the same time. The wound became infected by her pulling off the dressings, but results were not interfered with. All symptoms were relieved and she was in good condition when last heard from, two months after operation.

The sixth case was a married woman 40 years of age, with very relaxed abdominal walls. She had been in bad health for 4 or 5 years; was troubled with constipation, nausea, and vomiting; had vague abdominal pains, more marked on the right side; was considerably emaciated, very nervous and hysterical. Appendectomy was done a year ago, and her condition became worse. Rovsing's operation was done; there was marked ptosis of the liver, stomach, and colon. The suspensory ligament of the liver was shortened 2.5 inches, and the upper surface of the liver scarified to encourage adhesions to the diaphragm. Skiagrams made several months later show the stomach and colon in their normal positions.

The seventh case, a school girl 18 years of age, had not been well since entering high school, three and a half years ago. She was troubled in the right side, backache, headaches, constipation, nausea, cardialgia, and had lost 15 or 20 pounds in the past year. She had a muddy color (toxic); there were mitral systolic murmurs. Skiagraphy showed marked ptosis of the stomach and colon. After Rovsing's operation was performed, she made a rapid recovery, and gained 20 pounds in six months. The constipation was completely relieved; her color was clear and fresh, and all nervous symptoms have disappeared.

The eighth case, a female aged 36, was the mother of one child 16 years old. Her trouble began ten years ago, with indigestion and smothering spells. She was very nervous and constipated (bowels never moved without purgatives). Her color was bad, and she was very toxic. She lost 30 pounds in six months. She had her appendix removed two years ago, and her condition has been much worse during the past year. She was affected mentally. She had a pain in the left side along the œsophagus. She was a small slender woman (virginal type). A skiagram showed marked ptosis of the stomach and colon. Rovsing's operation was done under gas-oxygen anæsthesia. A high rectus incision was made showing adhesions of the omentum to the appendix scar. The liver was very low, and the

author's "round ligament" operation was done to shorten the suspensory ligament; the cæcum was infolded. She made a rapid recovery; showed marked improvement within two weeks and was eating full diet. The constipation was cured; her color became normal; and all nervous symptoms were relieved. She has gained 40 pounds in five months and says she is perfectly well.

The ninth was a case of miscarriage two years previous, followed by infection. An operation was performed eight months ago, and the pus tubes and appendix removed. She was much worse after this operation; was very constipated, constant belching, very nervous, pain in epigastrium and back, nausea. A skiagram showed the stomach much dilated and ptosed to within an inch of the pubis. A third of the meal was in the stomach after six hours. Rovsing's operation was done. Liver very low; author's "round ligament" operation was done to elevate the liver. Cæcum infolded. The wound became infected but healed by granulation without hernia. She is well and strong five months after operation; is completely relieved of the constipation and other stomach symptoms and has gained weight. This patient is a full-blooded negro and is the only case the author has seen in this race.

The tenth case, a female, 25 years of age, was troubled with nausea and vomiting almost daily for five years; was very constipated; very nervous and hysterical; color good and fairly well nourished. She had been much worse for the past few months; had been kept in bed for two weeks but continued to vomit. A test meal showed absence of HCl. Her appendix had been removed several years ago. Rovsing's operation was done under gas-oxygen anæsthesia. The stomach was not markedly ptosed. The colon, which was very long and very low, was sutured to the stomach, and the stomach was fixed in the usual way to support the colon. The sigmoid was very long and large (not removed). The Baldy-Webster operation was performed, since which time all nervous symptoms have disappeared; the nausea and vomiting have been relieved and she is back at work keeping books four months after operation and seems strong and well but has some slight constipation from the elongated sigmoid.

The eleventh case, a female aged 21, had been troubled with nausea and vomiting since menstruation began at 14 years of age. She vomited her evening meal almost daily; was troubled with cardialgia, emaciation, and had a bad color. A skiagram showed the colon and stomach below the brim of the pelvis. Rovsing's operation was done, with appendectomy. Four months after operation all symptoms of constipation and vomiting, were relieved. Her complexion is clear and ruddy; she eats anything she wishes, and is gaining in strength and weight.

The twelfth case, a female aged 36, had one child eight years old. There was no abdominal relaxation. She was very constipated; has always had headaches; was extremely nervous, worse since birth of the child. Pain was worse over the cæcal region. Fluoroscopic examination showed the stomach well below the brim of the pelvis, the cæcum dilated and colon very low. Under gas-oxygen anæsthesia Rovsing's operation was done, with removal of the appendix, and the cæcum was pleated over. She made a rapid recovery. The headaches and constipation were completely relieved five months after operation. She has gained 25 pounds; is practically free from nervous symptoms, and says she feels as well as she did when a girl.

The thirteenth case, a female aged 60, was practically bed ridden for ten years; constipation was marked, and she had left-sided abdominal pain. Her left kidney was removed three years ago for this condition. She was much worse after the operation. The abdomen was extremely tender. A skiagram showed the stomach and colon filling the pelvis. Rovsing's operation and the author's "round ligament" operation were done to elevate the liver. The left lobe of the liver was very low and was sutured to the diaphragm by through-and-through sutures of chromic catgut. The constipation is completely relieved, her color is good and she has gained 20 pounds or more and is very much improved five months after operation.

The fourteenth case, a female aged 30 years, had as chief symptoms, pain, nausea, vomiting, and constipation. Rovsing's operation was done; the stomach and colon were both very low. She has gained considerable flesh since the operation and is relieved of the constipation, but only a few months have elapsed since the operation and much more marked improvement is looked for.

The fifteenth case, a female aged 32 years, was troubled with marked constipation, pain in the left side, nausea and vomiting, loss of weight, marked nervousness, and cachexia. She was four months pregnant. Skiagrams showed a marked ptosis of the stomach and colon. Rovsing's operation with the author's "round ligament" operation for the elevation of the liver was done, with the removal of the appendix. Four months after operation she has gained 40 pounds; is completely relieved of the constipation and all nervous symptoms, with no disturbance of the pregnancy.

The eighteenth case, a female aged 30 years, had suffered with constipation, sick headaches, nausea and vomiting for a number of years. Rovsing's operation and appendectomy were performed and the cæcum pleated over. Two months and a half after operation she has been relieved of the constipation, headaches, nausea and vomiting and is taking on some flesh and is rapidly regaining her normal condition.

The last case, a female aged 45 years, had symptoms beginning two and a half years ago with indigestion, severe left-sided pain, marked constipation, and some emaciation. X-ray plates showed a ptosed condition of the stomach with a suggestion of an hour-glass condition. Rovsing's operation

with some repair of a pelvic condition was done. She is relieved of the constipation and the other symptoms are improving, but the operation is of too recent date to show the full benefit to be derived from it.

Truesdale, P. E.: Pylorus: a Study of Its Musculature. *Surg., Gynec. & Obst.*, 1915, xxi, 298.

Hypertrophy of the pyloric sphincter muscle and of the musculature of the pyloric antrum commonly exists in the presence of ulcer of the stomach or duodenum. The cause of this overgrowth of muscle is continued spasm. The degree of hypertrophy will necessarily be in proportion to the continued excess of function. It is further indicated that other lesions of the gastro-intestinal tract, such as cholelithiasis and appendicitis, may produce a considerable degree of hypertrophy of the circular muscle-bundle of the pylorus from pyloric spasm. Examinations at the operating table appear to confirm this view. The overgrowth of this pyloric muscle when marked is a definite obstruction to the normal evacuation of the stomach. Occasionally the muscle tumor is the chief cause of obstruction. The author believes that the cicatrix of an ulcer, especially in the duodenum, is rarely extensive enough to obstruct the pylorus.

Atrophy of the pyloric sphincter muscle follows gastrojejunostomy. When the stoma serves for the passage of all the stomach contents the pylorus ceases to functionate. Its musculature atrophies; control of the pylorus is lost; and the contents of the duodenum flow back into the stomach. This observation was made at a secondary operation upon a patient who had had a gastrojejunostomy done six years before.

The author refers to the possibility of a partial congenital stenosis being permanent. In this way he would explain an occasional case of indigestion dating back to childhood with no demonstrable lesion at the time of operation, except the presence of a perceptible thickening at the pylorus.

Strauss, A.: Clinical Aspect of Diseases of the Extraperitoneal Appendix Vermiformis. *Surg., Gynec. & Obst.*, 1915, xxi, 318.

The extraperitoneal appendix though not common is not uncommon. Its occurrence has been explained in the left half of the abdomen, and its journey to the right iliac fossa. Thus there is chance of its being arrested in transit and of the peritoneum being anomalously developed.

The appendix has been found wholly or partially extraperitoneal in from 0.6 to 6 per cent of cases in different series of cadavers examined (excluding 2 cases in a series of 25 subjects). Literature shows still fewer cases met with at operation.

The cases reported fall under three heads: (1) those presenting a straightforward picture of acute appendicitis; (2) those simulating a perinephritic abscess; and (3) persistent fæcal fistula.

Cases included under the first heading emphasize how careful the operator must be not to miss an extraperitoneal appendix which can be seen only after the peritoneum is incised and the cæcum raised.

The second group includes a case in which the abscess pointed in the lumbar region and contained actinomycetes, and later developed a subhepatic abscess. This was the only fatal case.

A second case illustrates the significance of fœtid pus and subsequent fæcal fistula from a lumbar abscess, and shows that these are signs which point to the appendix as the etiological factor.

Another case developed fæcal fistula after an operation in which the appendix was not found and was considered to have sloughed, but which was removed from its extraperitoneal position at a subsequent operation.

Meyer, L. B.: Primary Carcinoma of the Appendix. *Surg., Gynec. & Obst.*, 1915, xxi, 354.

Meyer reports 3 cases occurring in 707 consecutive appendectomies, reviewing 266 cases reported in the literature. The first case was reported by Merlin in 1838. In 1903 Moschcowitz was able to collect only 18 cases. Since then reports have been more frequent, because appendices are more frequently examined microscopically. This examination is absolutely necessary, for in only 10 per cent of the cases can the pathologist even suspect the condition by macroscopic examination of the specimen.

About one-half per cent of all removed appendices are carcinomatous (an additional argument for removing even apparently normal appendices during all laparotomies if possible without danger to the patient). The condition is most frequent in the third decade of life; next in the second and fourth. It is never recognized before operation, which is usually performed for an acute or chronic appendicitis. In fact, carcinoma of the appendix practically always exists at the site of a stricture, due to a preceding inflammation of the appendix. The condition is relatively benign, though a number of cases with metastases and death have been reported.

There is considerable controversy as to the exact pathology of the condition. Milner does not consider the condition a true carcinoma, but an inflammatory proliferation of the lymphatic vessel endothelium, and has applied to it the term "pseudocarcinoma" or "carcinoide." Aschoff calls it *Schleimhaut Nævus*. It is usually benign, but may become malignant in the same way as nævi in other parts of the body. Microscopically, two main types are to be distinguished, a small round-celled carcinoma, carcinoma simplex or scirrhous, and a cylindrical-celled type, resembling the ordinary type of intestinal cancer.

The author urges careful study and report of all cases, so as to clear up doubtful pathology and show how to diagnose cases before operation. He also suggests the possibility of some of the apparently pri-

mary carcinomata of a non-epithelial organ, like the peritoneum, being secondary to unrecognized appendix carcinoma.

LIVER, PANCREAS, AND SPLEEN

Walton, A. J.: Reconstruction of the Common Bile-Duct. *Surg., Gynec. & Obst.*, 1915, xxi, 269.

The author considers the operative technique to be undertaken in cases of obstruction of the common bile-duct. In many cases a cholecystenterostomy can be easily performed. However, if the gall-bladder is absent or atrophied the operation cannot be performed.

Such cases fall into two groups: (1) In one the duct is dilated and therefore can be united to the intestine. (2) In the other group, owing to the presence of a fistula, the duct is collapsed. It is in such cases that the greatest difficulty will arise at operation.

The various operations which have been previously undertaken are reviewed, and it is shown that although each operation may to a certain extent be applicable to individual cases none of them are free from objection and may indeed be wholly inapplicable in certain circumstances.

The author describes his operation whereby a new duct is formed which unites the stump of the common bile-duct with the duodenum. A rubber tube is sutured into the end of the duct with catgut, and a flap is cut from the anterior wall of the duodenum, being so fashioned that its base is below. The opening which is left by the turning down of this flap is then sutured in its upper part until it will just admit the rubber tube, which is inserted and the duodenum fixed as close to the common bile-duct as possible. The flap of duodenal wall, which consists of mucosa, muscle, and peritoneum, is then carefully sutured around the tube and on to the end of the severed duct, thus forming a new portion of duct bridging over the gap. The tube being sutured only by catgut is after a short period passed into the bowel, and thus is not likely to give rise to the formation of stones.

Walton reports a case of complete recovery by this method. He claims that the new duct can be made practically any length and that it is applicable to all cases. It is formed of all three coats of intestine and thus is not only impervious to the action of the bile but is unlikely to contract. The opening in the duodenum is more or less valvular so that regurgitation is unlikely to occur.

SURGERY OF THE EXTREMITIES

DISEASES OF THE BONES, JOINTS, MUSCLES, TENDONS. CONDITIONS COMMONLY FOUND IN THE EXTREMITIES

Da Costa, J. C., Funk, E. H., Bergeim, O., and Hawk, P. B.: Osteitis Deformans; Five Cases with Complete Metabolism Studies in Two Instances. *Report Jefferson M. Coll. & Hosp.*, 1915, vi, 1.

Osteitis deformans is the name given to a chronic inflammation of bones by Sir James Paget in 1876. The authors report 5 cases and in a review of the literature have found 208 additional cases. Cases reported as early as 1876 have been considered by Paget to be similar to those described later. The disease is rare, as is shown by the fact that only 3 cases were found among 30,000 admissions to Johns Hopkins Hospital and 3 in 38,000 at the Jefferson.

The family history in the first case, a woman aged 52, shows one sister with similar trouble. The patient's present illness began 12 years ago with bending of the left lower leg. Two years later aching pain began in the back, pelvis, and right thigh. Since then nearly all the bones have become involved and she has lost seven inches in height. The principal points in the physical condition were: slight enlargement of the head; trunk increased in anteroposterior diameter, abdomen short and wide; thickening and outward bowing of the left femur, tibia and fibula, and the right femur; thickening of the left femur; marked genu varus; thickening and curvature of all the bones of the arms; hand and foot bones normal. The urine and blood were normal; Wassermann negative. Bones with beginning involvement showed decrease of mineral salts; those in advanced stages showed irregular redeposits of salts. The surface was wavy but not rough; the medullary canal was filled in places with new bone; the articular surfaces were normal.

The family history of the second case, a woman aged 34, was negative. The personal history was not remarkable. No fractures. The present trouble began two years ago with limping pain in the right leg and thickening and bending of the right tibia. Pain still persists and is worse on exercise. There has been no loss in height but there has been a loss of 20 pounds in weight in the last year. Physical examination showed the head enlarged, cephalic index 81.3; thorax and abdomen normal; right tibia nearly twice as thick as the left and bowed outward; fibula and femur of same side also thickened. Bones of left leg normal. Urine and blood normal. Wassermann negative.

The third case, a man aged 28, suffered a fracture of the forearm at 14, which healed with good result. Lumps began to develop on the head at 8 years of age. There were no subjective symptoms. The head showed enlargement of left frontal and right temporal bone. Röntgen picture showed thickening particularly of outer table. Blood, urine, and Wassermann, negative.

A study of a larger number of cases shows the average age of onset to be 49, but many cases are reported beginning between 8 and 20. Sixty-seven per cent of cases occur in males. There are 14 instances given of two or more cases in the same family. A great majority of case reports show a negative Wassermann; however, Lannelongue and Fournier hold that it is a late manifestation of hereditary syphilis. No bacterial basis could be demonstrated by the authors, but a few cases are reported in which an organism was isolated from the bones. There is some evidence that the ductless glands play a part in the etiology. One case of the authors showed atrophy and two hypertrophy of the thyroid. Two showed enlargement and atrophy of the pituitary gland. Pain as a symptom is usually present in the early stages but not constant, usually referred to the back and legs. Headache is not common even with involvement of the cranial bones. The deformity is most frequent in the long bones especially the tibia. Gradual enlargement of the skull is the first feature in some of the reported cases.

Fractures are not features of this disease. Of 158 cases 14 developed malignancy, the tumor occurring either in the healthy or diseased parts of the bone. Of 8 patients traced to the end, 5 died of sarcoma. The authors made careful metabolism studies in 2 of their cases. Calcium, magnesium, phosphorus, sulphur, and nitrogen were determined in the ingested food and in the urine and fæces. It was found that a much higher percentage of calcium was retained by the patient than in normal individuals and that a lower percentage of sulphur was retained. This condition is opposite to that in osteomalacia in which the body gains sulphur and loses calcium. In other words, there is in osteitis deformans a gain of inorganic and loss of organic matter, while in osteomalacia the condition is reversed. Normal bone contains approximately 40 per cent organic and 60 per cent inorganic matter; bone in osteomalacia is about 70 per cent organic and 30 per cent inorganic; in osteitis deformans the proportion is approximately 20 per cent organic and 80 per cent inorganic.

In these experiments the nitrogen loss was not proportionate to the sulphur loss as might be supposed if these losses were due to catabolism of bone matrix, but this is explained by the greater conservatism of the organism for nitrogen, which results in its being resynthetized into other structures while the sulphur is eliminated. These findings are interesting in connection with the theory of decreased parathyroid function as an etiological factor in osteitis deformans. Since it is known that parathyroid insufficiency leads to disturbance of calcification, it might easily be inferred that decreased activity of the parathyroids is the cause of the retention of calcium and abnormal use of that element in overproduction of bone less compact than usual. W. A. Clark.

Zahradnicky, F.: Gunshot Injuries of the Large Joints (Die Schussverletzungen der grossen Gelenke). *Čas. lék. Česk.*, 1915, Nos. 23–25.

Among 2,331 injuries, 149, or 6.3 per cent, were gunshot injuries of the large joints. The one most frequently injured was the knee-joint, then the shoulder, the elbow, the ankle, the wrist, and least frequently the hip-joint. The joints of the left half of the body were more frequently injured than those of the right. The elbow was the only joint that was more frequently injured on the right side. Of the wounds 88 per cent were made by small calibered bullets, and 12 per cent with shrapnel or grenades. In 91.3 per cent of the cases the bullets passed entirely through the joint, in 8.7 per cent they lodged. This was because so many of the injuries were caused by rifle bullets. There were multiple injuries in 13.4 per cent of the cases.

Of the 149 cases, 57, or 38.2 per cent, were infected, 49 of them being bullet wounds and 8 shrapnel or grenade injuries. Forty-three cases, or 28.8 per cent were operated upon, all of them being infected cases. Resection was performed in 25 cases, or 16.7 per cent, with one death from sepsis, or 4 per cent; arthrotomy with drainage was done in 11 cases, 7.9 per cent, with 1 death from sepsis, 9.9 per cent; arthrotomy with necrotomy in 5 cases, 3.7 per cent; amputation in 2 cases, 1.5 per cent. Of the 149 patients, 2 died, 1.3 per cent.

The results on dismissal from the hospital were as follows: In the aseptic cases, of 19 gunshot wounds of the shoulder, 13 were good, 3 poor; of 5 of the wrist-joint, 4 good, 1 poor; of 19 of the knee, 15 good, 4 poor; of 5 of the ankle, 4 good, 1 poor. The results in the 64 aseptic cases were in 51 cases good, 79.7 per cent; in 13 cases poor, 20.3 per cent. Infected cases: shoulder 13 cases, 1 good, 12 partial ankyloses; elbow 4 cases, 1 good, 2 partial ankyloses, 1 total ankylosis; wrist-joint 5 cases, 1 good, 4 partial ankyloses; hip-joint 2 cases, both total ankyloses; knee-joint 11 cases, 3 good, 6 partial ankyloses, 2 total ankyloses; ankle-joint 4 cases, 1 good, 2 partial ankyloses, 1 total ankylosis. In all 38 infected cases with 7 good, 18.4 per cent, there were 27 partial ankyloses, 71 per cent, and 4 total ankyloses, 10.6 per cent.

In the aseptic cases the result was good in four-fifths of the cases, poor in one-fifth; that is, pain swelling of the joint or limitation of movement persisted. After the work was finished 51 new cases were added, distributed as follows: shoulder-joint 8 cases, 1 infected; elbow 5, 2 infected, both resected and drained; hip-joint 1 case, secondary empyema in fracture of the femur, necrotomy; knee-joint 28, 5 infected—3 of them drained with one death; ankle-joint 9, 2 infected, both drained. Altogether Zahradnicky treated 200 gunshot injuries of the joints, of which 133 were aseptic, 67 infected. There were 4 deaths from severe sepsis, or 2 per cent. A. Goss.

Seaborn, E.: The Treatment of Arthritis. *Canad. Pract. & Rev.*, 1915, xl, 433.

In considering arthritis, we must understand the capacity of repair of the various constituents of the joint.

Bone has a great capacity for withstanding attack through its power of proliferation and repair.

The capsule is most resistant, and persists through any irritation though it has no power of regeneration.

The synovial membrane is capable of marked hypertrophy, but the new tissue resembles granulation tissue and is phagocytic.

The cartilage is least resistant, and is incapable of regeneration.

The author classifies arthritis as (1) septic, and (2) rheumatoid.

Septic-arthritis occurs as the result of traumatism and following various infectious diseases. The organism is demonstrable in the fluids of the joint or in the capillaries of the synovial membrane.

Rheumatoid arthritis occurs in the course of chronic microbic infection. The organisms are not as a rule found as above, but may be found with difficulty encapsulated in any new formations, but much more easily in the adjacent lymphatic glands.

The anatomic changes in a diseased joint are: (1) serous infusions, which may be sterile; (2) hypertrophy of synovial membrane, fringe formation resulting in destruction of cartilage; (3) purulent arthritis; (4) erosion of cartilage, followed by organization of synovial fringes, and fibrous ankylosis; (5) bone may be deposited in the fibrous tissue, resulting in bony ankylosis; or (6) exostosis may result from chronic irritation.

In the treatment we must consider that cartilage is least resistant and must be first protected; this is done by extension.

In infectious arthritis, serous effusion may be helped by rest, pressure, and occasionally by aspiration. This treatment is also applicable to villous arthritis.

In purulent arthritis the joint should be aspirated and injected with 2 per cent formalin in glycerine, every two or three days.

Fibrous ankylosis should be treated by massage, passive motion, and forcible manipulations. Bony ankylosis is rare if extension is used.

If position is not good an arthroplasty may be undertaken. New bone formations may have to be removed.

The constitutional treatment of septic arthritis is that of the causative disease. Autogenous vaccines may be made from the joint or other foci.

In rheumatoid arthritis, all foci of infection must be removed. In many cases when the offending organisims cannot be found, they may be secured by culture from the lymph-glands draining the joint. Vaccines may be prepared and are very valuable. ARCHER O'REILLY.

FRACTURES AND DISLOCATIONS

Scudder, C. L.: The Operative Treatment of Fractures. *Boston M. & S. J.*, 1915, clxxiii, 346.

Four important factors have had a direct bearing on the development of fracture treatment during the past seventy-five years: anæsthesia, rendering painless manipulation possible; asepsis, by which compound fractures are assured safe care: röntgen ray, visualizing results; autogenous bone-grafts, the ideal fixation method. These four epochs entered approximately twenty-five years apart from 1846 on. Nevertheless results are still poor and present methods of treatment unsatisfactory.

Recent industrial legislation and social movements have placed emphasis on the economic loss from fractures in working men and the efficiency of treatment as measured by the time elapsing from the injury to resumption of work. Coupled with this demand by the industrial world for better results, there is the desire arising in the profession for more careful and scientific work in this field of surgery. In choosing from the available methods, operative and non-operative, one is confronted with abundant evidence of good results in both methods and with the experience of skillful men at either extremes. Bardenheuer, for instance, contending that exact anatomical approximation is not necessary to good functional results, practically never operates, while Lane operates on all fractures to secure accurate approximation.

The author believes that much harm has been done by indiscriminate operations by surgeons following the method made popular by Lane. He also voices the usual stereotyped warning that operations upon fractured bones should be done only by "surgeons of very considerable general surgical experience."

If properly chosen and properly performed operative treatment will preclude disastrous results, such as non-union, osteomyelitis, painful, stiff, and disabled joints near the fracture, just as surely as careful surgical treatment can prevent disastrous terminations in case of a gastric ulcer. The author operates more on fractures of the femur than he formerly did, especially in adults and if the fracture is transverse or slightly oblique. Better alignment is secured thereby, particularly of the normal anterior curve which is too often forgotten. The solution of the present inadequate handling of fractures is to be found in more intense specialization in surgery, to the end that in each community there may be men who are particularly interested and trained in bone surgery. W. A. CLARK.

Davison, C., and Smith, F. D.: Autoplastic Repair of Recent Fractures. *Surg., Gynec. & Obst.*, 1915, xxi, 366.

Autoplastic bone surgery is a satisfactory and dependable method of repairing skeletal defects and is especially applicable in the repair of a certain class of recent simple fractures, acting in sharp con-

trast to the use of metal plates, screws, and nails. These are resented by the tissues and invite infection while the living graft resists infection. The method will eventually eliminate the Lane plate in the repair of recent fractures. Autoplastic repair is especially indicated in that group of fractures in which it is necessary to expose the fracture by incision to effect reduction, requiring also internal alignment with fixation and external immobilization. The transplant maintains the reduction and grafts to the compact bone of the host under the following conditions: aseptic wound; a living transplant from the same individual without periosteum; graft in contact with the bone of the host and absolute external immobilization.

Occasionally the graft is absorbed, but the majority will remain intact. It unites to the compact bone of the host by the formation of osteoid tissue. Many bone-cells in the periphery of the graft remain viable while those situated in the center undergo necrosis. Eventually there is established in the graft a permanent circulation. The transplant is ultimately transformed into a complete osseous entity continuous with the compact bone of the host. As the functional demand upon the graft is removed, it undergoes absorption in from two to five years. The fate of the graft placed into cancellous tissue is identical with that of any other transplant. Many trabeculæ are deposited about the graft between the trabeculæ of the host, forming a more compact cancellous structure, but as the functional demand decreases the new bone is absorbed.

Sixteen röntgenograms and three photomicrographs are shown to substantiate the above deductions.

Boardman, W. W.: Pseudofracture of the Sesamoid Bone of the Big Toe. *Surg., Gynec. & Obst.*, 1915, xxi, 394.

Boardman reports five cases of division of the sesamoid bones of the big toe, and reviews the literature to date. From this study he concludes that congenital division of the sesamoids of the big toe may occur, usually bilateral, and most often in the tibial sesamoid. The line of cleavage is usually transverse. However, cases are reported, showing a division into four parts. Trauma, direct or indirect, applied to such a foot may be followed by pain, tenderness, and swelling beneath the sesamoid. Trauma, direct or indirect, may also result in a true fracture of a normal sesamoid, with a similar train of symptoms. Hence the differentiation of the two conditions is often difficult, fracture being favored by the irregularity of the line of cleavage, its presence on one side only, the occurrence of fractures of adjacent bones or by the occurrence of healing. The symptoms probably result from a low grade inflammation of the metatarsophalangeal joint. Treatment should be conservative, consisting in rest and protection, operative removal of the fragments being reserved for resistant cases.

Sympson, E. M.: Congenital Dislocation of Right Foot with Almost Complete Absence of Right Fibula. *Brit. M. J.*, 1915, ii, 400.

The author reports the case of a lad aged 13, who was admitted to the Lincoln County Hospital with a malformation of leg and foot which had been noticed at birth. The patient walked at the usual age, resting the right foot on the right great toe. He ran well, played football, etc., became a scout when 11, and did all the drills and marches without difficulty. A year ago he began to suffer from backache after long walks, due to the tilting of the pelvis from the shortness of the right leg. Last March this deformity was noticed by the medical inspector at school, and found to be very marked.

Upon examination the right foot seemed as though it had been rotated outwards for nearly a quarter of a circle and then turned over so that its dorsal surface extended almost directly forwards and its plantar surface backwards. The power to move the foot on the ankle existed, but the movement was backwards and forwards instead of up and down. The boy walked on the end of the tibia which was enlarged and made a good "stump." There was a shortening of 2.5 inches of the right tibia (measuring from patella to inner malleolus), and, of course, owing to the absence of the foot beneath the tibia there was much more difference in the total length of each limb.

On June 5, 1915, a flap was formed from the dorsum of the foot, the tendons and ligaments were divided, the incision carried upwards and downwards over the os calcis, the tendo achillis cut, the flap turned upwards and outward, making the wound like an inverted U. This healed by first intention, and the scar is well out of the way of any vertical pressure.

M. S. HENDERSON.

SURGERY OF THE BONES, JOINTS, ETC.

Gemmill, W.: An Operation for the Obliteration of the Cavity in the Tibia Remaining After Sequestrotomy. *Brit. M. J.*, 1915, ii, 432.

The author cites a case of a man, aged 61, who had a large cavity in the head of the tibia as a result of a former operation for sequestrotomy. The cavity was closed by the removal, subperiosteally, of a wedge of bone, longitudinally, on either side of the cavity, and forcing the roof down on to the floor bringing into contact the previously curetted walls of the cavity. Accuracy of the bone-flaps is quite necessary for a good result, which in the above case proved to be quite satisfactory.

C. H. BUCHOLZ.

Brown, W. L., and Brown, C. P.: Further Observations on the Fate of Free Bone Transplants. *J. Am. M. Ass.*, 1915, lxv, 1007.

By permanency in bone-grafts the authors mean that the graft should last as long as the life of the patient. In this sense they hold that no grafts are permanent, as they are all ultimately absorbed,

whether with or without periosteum, and any supposed growth reported by some observers is only temporary. Exception is taken to the statement of McWilliams and Albee that periosteum is important in supplying nourishment to the graft, in view of the fact that living bone does not depend upon the periosteum for blood supply since the vascular connection between the bone and its covering is very slight. Whatever delay in absorption there may be in periosteal grafts, as compared to the aperiosteal type, is due not to nourishment supplied but to the mechanical protection which such a covering affords.

If it were true that circulation was the all important factor and the periosteum the source of the blood, then the greatest growth and the longest life should be found in grafts covered completely, or nearly so, with periosteum. Such a specimen is obtained from the spine of the scapula, but the authors' experiments with it show that when transplanted it is absorbed; in one case it was completely absorbed in thirty-nine days. Experiments with osteogenetic function of the periosteum showed (in all except one experiment) that it did not possess such function.

Subperiosteal resections of one inch of ulnar were made in the right and left legs of a dog. On the right the ends were covered with caps of thick tinfoil and only a small extension of bone grew down from a point above the cap on the proximal end, while on the left the gap filled in completely with solid union. This seems to indicate that regeneration is from the ends of the bones rather than from periosteum. W. A. CLARK.

ORTHOPEDICS IN GENERAL

Batten, F. E.: Unusual Manifestations of Poliomyelitis. *Clin. J.*, 1915, xliv, 305.

The author reports several cases showing some unusual conditions in patients suffering from poliomyelitis, at least they were so diagnosed. In one case there were violent spontaneous movements of an athetoid character in the left hand. In another case there was rigid extension of the legs at the hips, due apparently to pain on attempted motion. In the third there was marked rigidity of the right leg in a flexed position. In the fourth there was marked involvement of the neck muscles and none of the legs, arms, or trunk. In the fifth the probable diagnosis of poliomyelitis occurring during intrauterine life was made. In the sixth there was ataxia and probably a focus of the disease in the cerebellum. The last two cases are given as evidence that poliomyelitis may produce a toxic polioneuritis. GEORGE I. BAUMAN.

Hoke, M., and Hodgson, F. G.: Cases Illustrating Orthopedic Treatment of Some of the Disabilities Resulting from Infantile Paralysis. *South. M. J.*, 1915, viii, 788.

The authors state that with the exception of paralytic scoliosis, the deformities of infantile paralysis can be entirely corrected, and the lameness greatly decreased by surgical procedures of orthopedic nature. They present several very excellent rules for the surgical treatment of infantile paralysis, as follows:

1. The plan of campaign should look forward to the minimum use of, or preferably the entire removal of, the apparatus.

2. To accomplish this, operation should be done which will enable the skeleton to bear weight so that the tendency to relapse after deformities have been corrected will be removed.

3. The tendon transplantation and the insertion of silk ligaments are of value only when the skeleton is properly balanced.

4. Accurate skeleton balancing operations remove the necessity for the use of braces in most cases, although braces have their periods of usefulness.

5. Without prolonged post-operative massage and muscle training, operations are largely useless.

DEFOREST P. WILLARD.

Stone, C. A.: Treatment of Congenital Club-Foot. *J. Mo. St. M. Ass.*, 1915, xii, 406.

The author urges the early treatment of club-foot, and advises that correction should be begun as soon after birth as possible. He reviews the various theories of the cause of club-foot. He believes that the periods of ossification of the various tarsal bones may play an important part in the etiology. He says that in considering the time of ossification of the tarsal bones the fact struck him that since the calcis, astragalus, and cuboid centers appear at 6, 7, and 9 months respectively, and remembering that the internal muscles are stronger, then given a predisposing factor, we have the explanation of 80 per cent or more of club-foot.

The treatment is operative and non-operative. The non-operative consists in gradual correction with anæsthesia. The foot is held in as nearly a correct position as possible. It is well padded by cotton and a plaster cast is applied, with the knee flexed, the bandage starting on the inner side of the foot running across the bottom, across the dorsum to the starting point, and continuing up the leg to well above the knee. The cast should press against the great toe, and room should be left on the outer side for swelling. The plaster is changed every week or ten days, until correction is secured; the varus is first corrected and then the equinus. When correction is secured, the plaster is carried to the knee and the patient is allowed to walk upon it. Later, massage and manipulation are used, and a broad-toed shoe raised one-fourth inch on the outer side is worn. The danger of relapse is pointed out.

In infants the author uses a celluloid splint which may be removed, allowing massage and manipulation.

In older children, correction may be secured by manipulation under anæsthetic, with tenotomies of the plantar fascia and tendo achillis if necessary.

If the deformity is resistant, the removal of a wedge is safer and quicker than more forcible manipulation.

The author does not attempt forcible correction for ten days after operation, at which time the wound is healed and there is less danger from trauma and swelling.

The second manipulation is done under anæsthetic. The after-treatment is the same as in non-operative cases.

The author's conclusions are as follows:

1. Club-foot should be corrected at once, then anæsthetics and operation are unnecessary.

2. Older babies need tenotomies before proper correction can be done.

3. Bruising of the resistant foot should be avoided, and even if the child is young less damage is done by the knife.

4. In older children with badly deformed feet tenotomies alone should not be attempted. The removal at once of a wedge of bone will save the patient much time and pain.

5. Any club-foot can be corrected, but it is very important that the responsible parties be made to understand that they will have to do their share, and that it will usually take a long time.

6. The best form of appliance to keep club-foot in position is plaster of Paris; muscle atrophy is negligible.

ARCHER O'REILLY.

Soule, R. E.: The Bone-Pin Graft in Painful Flat-Foot, Paralytic Valgus, and Other Painful Deformities of the Foot. *N. Y. M. J.*, 1915, cii, 350.

The author refers to his method of ankylosing the astragaloscaphoid joint in the above conditions, and describes in detail a supplementary procedure to strengthen this arthrodesis.

The astragaloscaphoid joint is exposed through a dorsal incision, the articular surfaces are thoroughly removed and the foot adducted to the normal position. With an electric motor drill a hole is made through the scaphoid into the head of the astragalus. A bone pin is prepared from the tibia and driven through the drill hole above mentioned, holding the bones firmly and accurately.

A plaster splint holds the parts in position for six or eight weeks, after which an adhesive plaster strapping is relied upon to give further support for a time, while the first attempts at walking are made. Two patients operated upon in this manner walked without crutches or canes twelve weeks afterward.

F. J. GAENSLEN.

SURGERY OF THE SPINAL COLUMN AND CORD

Second Report of the Committeé on the Treatment of Structural Scoliosis to American Orthopedic Association. *Am. J. Orth. Surg.*, 1915, xiii, No. 1.

The committee in its second investigation had each physician whose work was to be reviewed, present a new series of six previously untreated cases. These cases were examined and recorded by one or more of the committee before treatment was begun.

The record of the deformity consisted of stereoscopic photographs of the back of the patient, both the standing and the forward bending positions, and of röntgenograms in the recumbent position. Both were standardized by means of the apparatus provided by Bucholz and Osgood.

After six months' treatment the cases were again examined in the same manner. The cases were divided and grouped according to the initial severity of deformity. There were three groups of methods presented: (1) after the method of Lovett; (2) after the method of Forbes; and (3) after the method of Abbott.

The author considers the report fair and just and gives the summary as offered by the committee as the result of its second investigation:

"1. No case of overcorrection of the elements of deformity in structural scoliosis has been presented to the committee, in which it has been permitted to observe and record the condition of the patient from a time preceding the beginning of treatment.

"2. The time allowed by the committee has been sufficient in its judgment for such a demonstration, were it possible in the respective patients and by the respective methods.

"3. The same statements may be made with respect to complete correction of the elements of deformity.

"4. The amount of correction demonstrated to the committee by means of the method of Forbes is unsatisfactory and is to be regarded as an entirely insufficient reward for the amount of labor, discomfort, and other inconvenience which is involved.

"5. In mild cases of undoubtedly structural scoliosis, and perhaps in some moderately severe cases, considerable degrees of correction may be achieved by means of the method of Lovett and Abbott and by Kleinberg's brace.

"6. It seems probable that greater degrees of correction may be obtained with the flexed, than with the extended, position of the spine.

"7. It does not appear that the use of extreme force is justified by the results which are to be obtained from it.

"8. In order to have reciprocal application to the given case, all records should be made with the patient in the same position; this refers to the clinical, photographic, and röntgenographic record and to the horizontal or upright position of the patient.

"9. For purposes of record the upright position is to be preferred."

J. O. WALLACE.

Kleinberg, S.: The Treatment of Rigid Rotary Lateral Curvature of the Spine by a New Brace. *N. Y. St. J. Med.*, 1915, xv, 350.

Kleinberg describes a new brace to take the place of the Abbott cast in scoliosis. This apparatus consists of thoracic and pelvic steel bands crossed by several upright bars for attaching canvas bands for pressure. It is made by outlining a pattern over a plaster torso from a temporary Abbott cast made in extreme correction. The advantages of the brace over the cast are several: the patient is more comfortable and gets used to the apparatus quicker; the brace is much lighter; the corrective pressure more gradual; more of the chest is exposed for watching progress; and only one brace is necessary.

Cases favorable for treatment are: single curves of moderate degree, long dorsal with short compensatory lumbar curves, mild S-shaped curves, moderate lower dorsal curve with very little compensatory curve.

Unfavorable cases include: curves with sharp angulations, high dorsal curves, marked lumbar distortion, severe S-shaped curves, and congenital malformations.

Of the author's 30 cases, 11 showed marked improvement, 8 mild improvement, but not one showed complete correction. He concludes that though the treatment must be protracted, it does obtain good results in mild and moderately severe types, and that the brace accomplishes the result as well as the plaster. ROBERT G. PACKARD.

Wilson, J. C.: Bone-Graft for Tuberculosis of the Spine. *Internat. J. Surg.*, 1915, xxviii, 300.

Following a very brief review of the history, Wilson describes his method of bone-grafting in tuberculosis of the spine and cites 20 cases.

The graft is obtained from the internal surface of the tibia, and is about three-fourths to three-eighths of an inch wide and of sufficient length to extend well above and below the affected area.

The spinous processes in the diseased area are exposed by a semi-elliptical incision and split by an osteotome or a heavy cartilage knife, care being taken not to separate the posterior spinal ligaments from the spinous process. The graft, being scarfed if necessary to facilitate bending, is laid between the split processes and held in place by suturing the ligaments as near the separated portion of the processes as possible over the graft. The skin and subcutaneous tissues, closed by silkworm gut, further hold the graft in place. The patient is then kept prone in bed for four weeks.

In cutting the graft Wilson recommends the Albee saw, but says that the ordinary, semi-elliptical plaster saw may be used, care being taken not to fracture the graft.

He gives a report of 20 cases in which this method was used with success. He concludes that this procedure is rational and safe, and is to be considered in all cases with symptoms of an active process, provided the general condition will permit of operation. PHILLIPS M. CHASE.

SURGERY OF THE NERVOUS SYSTEM

Borchardt, M.: Gunshot Injuries of Peripheral Nerves (Schussverletzungen peripherer Nerven). *Beitr. z. klin. Chir.*, 1915, xcvii, 233.

As consulting surgeon of the third army corps and surgeon of the military prisoners at Zossen, Borchardt has seen several hundred cases of nerve injury, and has operated upon more than 70. In this article he gives the histories of 56 cases. Of the series, 17 were injuries of the radial, 8 of the median, 7 of the ulnar, 7 of the ulnar and median, 1 of the musculocutaneous, 8 of the brachial, cervical, or lumbar plexus, 8 of the sciatic. Excellent plates are given, containing 39 illustrations showing the operations.

The indications for operation were decided upon according to the principles laid down by Oppenheim, Cassirer, and other noted neurologists. Operation was performed when the neurological findings indicated that there was severe injury of the nerve, either from partial or total section of the nerve or from scar formation around it. He operated if there was complete motor paralysis, complete reaction of degeneration, or severe disturbances of sensation. Operating on these indications he met with negative findings on operation in only 2 cases. Among the 56 cases, in 18 the nerves were found completely, and in one partially, severed. The stumps were generally swollen, with club-shaped ends. In the other cases there were more or less extensive scars, and sometimes foreign bodies were embedded in the nerves, such as bits of metal or cloth, fragments of bone or muscle fibers.

In operation the greatest care was taken to control hæmorrhage so as to avoid the formation of even the smallest hæmatomata, which might lead to renewed scar formation. If the tissue around the nerve showed cicatricial changes, a sheath of fat or soft fascia was put around the nerve. The chief factors in the early restoration of function are careful suture, absolute asepsis in operation, the avoidance of hæmatomata and early movement, massage, and electrical treatment.

Direct suture is to be preferred to all other methods. Care must be taken in suturing to bring the corresponding nerve-tracts into exact apposition. The muscles should be spared all injury so far as possible. If palpation or exploratory incision shows cicatricial tissue it should be excised. Of course the ideal procedure would be to excise into sound nerve-tissue, but the histological examination of apparently normal cross-sections of nerves gave surprising results. The plates show some

histological pictures of cross-sections of nerves that were apparently normal, but the microscope reveals the fact that they contain considerable cicatricial tissue, and in some places there are no nerve-fibers left at all, or else there are only tubes of nerve-tissue filled with scar tissue. But Borchardt believes, as does Cassirer, that it is better to suture such nerves, even though they contain some scar tissue, than to remove such large pieces that they cannot be sutured together. If only a part of the nerve is injured, electrical examination will show what part of it should be resected.

Borchardt recommends that operation be done as early as possible, because it is technically easier then, and because early operation prevents contractures of the muscles and joints and trophic disturbances. In the author's own cases the time between the injury and the operation varied from two weeks to nine months. In 6 cases there were also injuries of the vessels, but the vessel wounds closed spontaneously without the formation of aneurisms. Among the 56 cases, 25 were under observation longer than three months; 21 of these were improved and 4 not improved. The results were particularly good in 3 cases of nerve-suture, function being completely restored. Borchardt believes that the results of operation have been given more praise than they deserved. A. Goss.

Grosse: Gunshot Injuries of Peripheral Nerves (Schussverletzungen peripherer Nerven). *Beitr. z. klin. Chir.*, 1915, xcvii, 306.

Grosse reports 33 cases which he has operated upon. He always operates without cutting off the circulation from the limb, dissects away all cicatricial tissue as far as possible, and resects the nerve-stumps thoroughly. He sutures the nerves with fine silk and round needles, and when possible embeds them in muscle tissue, without putting any sheath around them. But where the nerve must pass through scar tissue, he makes a sheath for it of a calf's artery, which he prepares like catgut and keeps ready for such cases. These cases have all healed uneventfully, even when the wound was infected when the operation was performed.

Among 20 operations, 13 of suture, 6 of neurolysis, and 1 of splicing, performed from October, 1914, to March, 1915, there were good results in 8, partial results in 6, and in 6 no result. Of 17 further operations, 11 of suture, 5 of neurolysis and 1 of splicing, from April to August, 1915, 4 have shown good results, 1 partial success, and 12 thus far no result. All the good results were in the upper extremity. The time until function was restored varied from three weeks in a case of suture of the radial to 7 months in a case of neurolysis. A. Goss.

Bittorf, A.: Gunshot Injuries of the Peripheral Nerves (Über Schussverletzungen der peripheren Nerven). *Neurol. Zentralbl.*, 1915, xxxiv, 556.

Bittorf divides gunshot injuries of peripheral nerves into two groups. The first and larger group includes the injuries of the radial, the brachial plexus, the sciatic and its branches. Motor paralysis is the prevailing symptom; disturbances of sensation are slight or entirely lacking. Pain is rare, though it sometimes appears in injuries of the sciatic. The prognosis is unfavorable, for the time required for recovery is very long. Even in cases where operation has not shown any severe injury, total paralysis often persists after many months. In the second smaller group the disturbances are chiefly vasomotor, secretory, and trophic. Subjective disturbances of sensation and extreme pain are common. Injuries of the median and ulnar generally belong in this group.

The prognosis even without operation is quite favorable. In the first group early operation is recommended. An unnecessary operation does no harm. Even by waiting one is not always prevented from performing such operations, but with the lapse of time the conditions for operation become more unfavorable. Passive movements of the joints are necessary in all cases to avoid stiffness and contractures. In the second class of cases conservative treatment is preferable — hot air, vapor baths, and electrical treatment. A. Goss.

Tuffier, T.: Treatment of Injuries of the Nerves by Projectiles (Traitement des lésions des nerfs par projectiles de guerre). *Bull. et mém. Soc. de chir. de Par.*, 1915, xli, 1911.

Tuffier reported the work of Dumas on 280 cases of nerve lesions during the war. From his results he concludes that section and suture of the nerves should be practiced only when no other treatment is possible. Among his 280 cases, nerve-suture was practiced in only 19, and in none of these cases was motion restored.

The treatment of choice is to liberate the nerve from scar tissue and make a sheath for it of some substance that will protect it from further cicatrization. The nerve should be handled as little and as gently as possible, and the cicatricial tissue developed within the nerve itself should not be touched. Even where the nerve has been completely severed the conservative method is still indicated.

Dumas reports a case to illustrate his method of leaving a bridge of sclerotic tissue about the size and shape of the nerve between the severed ends. Gradually nerve-fibers grow through this from the distal to the peripheral end and function is restored. After the nerve is freed it must be protected, and he finds that the best material for this purpose is fatty tissue. This may be taken from the patient himself or from some one else. Its softness and elasticity make it an ideal material for protecting the nerve from compression by new-formed scar tissue. Other materials frequently used, such as hernial sac, veins, and aponeurosis, are not thick enough to give as efficient protection.

He has found this method particularly effective in those very painful lesions of the median nerve

which many operators have reported as hopeless. In 32 cases of very painful paralysis the pain has disappeared, except in one extremely stubborn sciatic case. In 173 cases in which fat was used he has never seen the slightest bad effect from its use. A. Goss.

Stoffel, A.: The Technique of Neurolysis (Über die Technik der Neurolyse). *Deutsche med. Wchnschr.*, 1915, xli, 1243.

Stoffel has recently had occasion to examine a number of soldiers on whom neurolysis had been performed, and found that the results were very unsatisfactory. This was due to the fact that the operators had merely freed the nerve as a whole from scar tissue and enveloped it in muscle or fascia. This is not sufficient. The nerve is made up like a cable. When it is injured there is not only effusion of blood and formations of scar tissue around the whole nerve, but the individual cords of the cable may be bruised or torn, the connective tissue between them is injured, and scar tissue is formed within the cable.

In operating the surgeon should consider not only the perineural cicatricial tissue, but the endoneural scar tissue. The perineural scar is first carefully dissected off. Then the individual nerve-tracts should be taken up one at a time and followed through the injured region. If the endoneural connective tissue is soft and the individual nerve-cords are soft there is no endoneural scar; but if the nerve feels hard and the individual bundles are hard to separate from one another there is intraneural scar tissue. Great care must be exercised in separating the individual bundles not to injure them.

This technique requires considerable skill on the part of the surgeon and accurate anatomical knowledge of the nerve with which he is dealing. The motor tract should be attended to first; the sensory ones are of secondary importance. When all the tracts have been freed from scar tissue the whole nerve is enveloped in whatever substance has been chosen for the sheath. Stoffel has been using calves' arteries hardened in formalin, but recently has been using calves' peritoneum hardened in the same way, because it is not so thick as the arteries. He has found that the nerves heal much more quickly if they are fixed in a relaxed position; so he fixes the joint for three or four weeks in a position so that the nerve will be relaxed. Sometimes he finds that individual cords in the nerve-cable are injured to quite different degrees, so that some of them require to be severed and sutured, while others do not. He has frequently done nerve-suture for part of a nerve and neurolysis for the rest. By using this technique he has had surprisingly good results in practically all of his cases. A. Goss.

Law, A. A.: Some Modern Phases of Neural Surgery. *St. Paul M. J.*, 1915, xvii, 589.

The author gives his personal experiences and observations on the recent advances in neural surgery. He holds that the theory which applies best to regeneration of nerves is that which postulates that all nerve regeneration must take place from the proximal ganglionic cells and axones, the latter projecting themselves onward in an effort to bridge the nerve deficiencies. He does not uphold the theory of Forssman, who believes in the chemotactic action of nerve-tissue on regenerating nerves. He lays special emphasis on the importance in accurately suturing nerves that have been severed, so as to avoid a neuroma. He draws attention to the reëducation of a nerve with a highly specialized function when that nerve has been implanted into an ordinary motor nerve. He does not advocate cutting flaps from nerves in order to bridge defects, because the viable axones are cut across and destroyed, a raw nerve area is exposed to cicatricial contraction and the ends of living axones are not approximated. It is important that the ends of the proximal axones be cleanly sectioned with a sharp knife and not crushed by scissors. In suturing nerves he advocates the use of chromic catgut sutures which are passed through the nerve-sheath alone. Silk, he thinks, acts more as a foreign body than catgut.

End-to-side anastamosis where a longitudinal slit is cut in a neighboring nerve and the distal fragment of a degenerated nerve is stitched in, may be done successfully provided the slit cuts some of the axones across. He quotes Levings as showing that where the proximal and distal fragments of a resected nerve were implanted between parallel muscle-fibers and protected by these fibers, that regeneration occurred along the plane of the muscle fibers. He thinks that foreign bodies introduced to guide nerve growth, such as tubes of decalcified bone, magnesium or gelatine, cargile membrane, eggshell membrane, wax or paraffine are not feasible, but rather he advocates the use of tubes made of fascia from the patient's own body. He thinks this is a better procedure than bridging the nerve-defects with a sensory nerve, because in the grafted fragments the axones are destroyed, the perineurium alone acting simply as a conduit, where the function of the central sensory nerve is destroyed. Segments of the saphenous vein, he has found, collapse, and the intima grows tightly shut to the intima of the opposite side.

In addition to the value of fascia in making conduits for the outgrowth of nerve, the author has made use of it in replacing defects of the dura.

The time of regeneration in a cut nerve varies markedly from four months to several years. Sensory nerves regenerate first, yet there is never complete restoration of sensation after secondary suture as there is of motion in a motor nerve. Contracted nerves stand extensive stretching without losing their function. Nerves injured in fractures should be exposed and wrapped in fat or aponeurotic flaps for protection, and transplanted to another neighborhood where pressure is relieved.

HARRY G. SLOAN.

SURGERY OF THE SKIN, FASCIA, AND APPENDAGES

Skinner, E. H.: Röntgenotherapy for Angiomata; Report of Cases. *J. Mo. St. M. Ass.*, 1915, xii, 411.

Skinner states that the röntgen treatment of these lesions is based upon biologic röntgen effects which have been proved by experimentation and practice. The tunica intima of blood-vessels is especially radiosensitive, and the application of the röntgen ray in measured filtered doses eventually leads to the obliteration of the vessel channel. The ray also promotes the obliteration and contraction of tissue elements. These biologic effects are desired to promote the involution of hæmangiomata and lymphangiomata. The use of röntgen filters are necessary to prevent the superficial skin or mucous membrane reaction which would certainly ensue without their use. The amount of filtration will vary with the depth of the lesion beneath the skin surface and the penetrative quality of the ray used.

Skinner advises the administration of massive doses at increasingly longer intervals. The longer the lesion has been under treatment the more rays will be required to obtain further benefit. He reports a case of cavernous hæmangiomata at the inner canthus and two cases of lymphangiomata which were successfully treated. He states that each of these cases presented a difficult, if not impossible, surgical aspect, and the favorable outcome of this class of cases after careful röntgen therapy should promote the substitution of a painless non-deforming röntgen treatment in preference to mutilating surgical procedures.

MISCELLANEOUS

CLINICAL ENTITIES — TUMORS, ULCERS, ABSCESSES, ETC.

Walther, C.: Intraspinous Treatment of Tetanus with Large Doses of Antitoxin (A propos de tétanos et de la sérothérapie intrarachidienne massive). *Bull. et mém. Soc. de chir. de Par.*, 1915, xli, 1904.

Walther presented a report of the work of Pignol, Brisset, and Lémonnier in the treatment of tetanus. There has been a tendency recently to give very large doses of antitoxin, no matter how administered. Castaigne has given as much as 760 ccm. in 12 hours. The above authorities have had much better and prompter results by giving the antitoxin intraspinously. They have brought about recovery with less than 200 gm. of serum. After giving the injection they place the patient's body in a slanting position with the head down. Another part of their treatment is careful treatment of the wound, free incision, removal of projectiles, and exposing as large a surface of the wound as possible to the air, in addition to the use of suitable antiseptics. The objection has been urged to their results that they took only favorable cases, those with a long incubation period, but they say they took the cases without selection and that, moreover, a parallel series of cases not given their treatment all died, though some of them had long incubation periods.

Among 36 cases 3 died of complications, septicæmia, pulmonary gangrene, and pneumonia. Of the remaining 33, 6 died, or 18 per cent. Three of these cases were extremely acute forms of respiratory tetanus with paralysis of the diaphragm and the respiratory muscles. Leaving these out of account, gives 3 deaths in 30, or 10 per cent. The treatment should be used more extensively and further statistics collected. A. Goss.

Crile, G. W.: The Phenomenon of Acidosis and Its Dominating Influence in Surgery. *Ann. Surg.*, Phila, 1915, lxii, 257.

Animal as well as plant life demands for its continuance an alkaline medium; therefore, since the activities of life constantly produce acids, the acid by-products of energy must be neutralized. Exertion, emotion, and all other activators of energy transformation cause an increased output of adrenin. They also cause increased acid by-products.

Experimentation has shown that the injection of CO_2 causes increased adrenin output and increased respiration, but no other symptoms; and it has been found further that the brain, the lungs, the adrenals, and the liver are concerned in the neutralization and elimination of the acids resulting from energy transformation, the brain governing the mechanism by which the acutal processes are accomplished.

It is possible to see the trend of a case in which mild acidosis already exists and to apply means by which to ameliorate the physical changes which are caused by the presence in the system of abnormal amounts of acid. Anæsthetics, chloroform, and ether in greater degree than nitrous oxide, produce increased acidity in the blood as well as increased respiratory rate. This explains why the administration of an anæsthetic to a starved patient, with gastric or duodenal ulcer for example, may cause death by precipitating the impending acidosis.

In greater or less degree acidosis is present in every abnormal condition of the body which can be traced to excessive kinetic activations, and the maintenance of the normal potential alkalinity of the body is of vast clinical importance. The factors increasing acid by-products should be controlled as far as possible by the surgeon. The anociated operation minimizes these injuring factors, but the

patient should also be protected in advance by being given water, glucose, and sodium bicarbonate, and the post-operative state also may be improved and convalescence hastened by these measures.

Simpson, F. F.: Right-Sided Hypertension with Occasional Cardiac Dilatation as Post-operative Complication. *J. Am. M. Ass.*, 1915, lxv, 941.

Simpson points out that persons with weakened myocardium from excessive business or social cares, by marked anæmia, or by prolonged absorption of bacterial toxins, biliary poisons, etc., are serious risks for surgical operation. To expose such a person to prolonged general anæsthesia with the patient in the Trendelenburg position, and later give unnecessarily large amounts of normal salt solution intravenously, increases the dangers.

Experiments were carried out on dogs to make observations parallel to those made on humans. Normal dogs, dogs with hyperthyroidism, with weakened circulation from prolonged general anæsthesia, by extreme Trendelenburg position, and by intravenous injections of 0.09 per cent sodium chloride solution were used with interesting and quite conclusive results. Dogs with hyperthyroidism and enlarged thyroids showed the depressive influences of posture, ether, and intravenous injections more quickly and more profoundly than normal dogs.

Analysis of the last 2,000 abdominal operations showed clinical symptoms of right-sided hypertension or cardiac dilatation in 42 patients.

Extensive observations were made on 115 consecutive abdominal operations on the cardiovascular system, clinically, and röntgenographic studies made before and after operation. No typical clinical picture of marked increase in venous tension or acute cardiac dilatation occurred.

Minor changes warranted the following conclusions as regards right-sided hypertension:

1. When the vascular measurements were not relatively greater in proportion to the cardiac measurements, there was no circulatory embarrassment. In 38 cases no embarrassment was observed.

2. When the vascular measurements were relatively greater than the circulatory measurements, circulatory disturbance did occur in 24 per cent of the cases. In 50 cases embarrassment was observed twelve times.

Simpson summarizes his ideas as follows: Right-sided hypertension does occur as a post-operative complication. It is usually slight and causes no alarming symptoms. It occasionally causes circulatory disturbance, always with a rapid pulse. In rare instances it leads to right auricular dilatation or even to dilatation of the entire heart. It is more likely to occur when the myocardium is weakened by disease. It may readily be precipitated or intensified by excessive ether, prolonged extreme Trendelenburg position, or by rapid intravenous injection of large quantities of salt solution while the heart is already embarrassed.

It should be promptly recognized and treated by slight elevation of the head of the bed and the administration of a little morphine and cardiac stimulants.

CARL R. STEINKE.

SERA, VACCINES, AND FERMENTS

Herzfeld, E.: Specificity of the Abderhalden Reaction (Zur Frage der Spezifizität bei der Abderhaldenschen Reaction.) *Deutsche med. Wchnschr.*, 1915, xli, 1151.

Herzfeld presents three tables showing the results of the Abderhalden test on the sera of pregnant, non-pregnant, and mentally diseased women. These tables show that almost all normal, non-pregnant sera catabolize placenta. Of the organs examined, normal serum had the strongest catabolic action on spleen, placenta, and ovary. The pregnant sera also digest these organs most actively. Normal women and women with psychoses showed no appreciable difference in their ability to catabolize different organ tissues. It seems that all sera possess similar catabolic products. They all seem to contain substances that digest albumins, globulins, tissue proteids, glycoproteids, and albumins that are soluble in alcohol. The results of the experiments represented here seem to disprove Abderhalden's theory of the specificity of ferments.

A. Goss.

Keitler, H., and Lindner, K.: Abderhalden's Dialysis (Über die Abderhaldenschen Dialysiermethode). *Wien. klin. Wchnschr.*, 1915, xxviii, 549.

The authors first discuss some points in their technique and then take up the results of their work. The chief interest in their work lies in the field of the diagnosis of pregnancy. Among 24 pregnant cases 19 catabolized placenta only. One case gave a negative result with all substrates, one catabolized carcinoma markedly, another only slightly, and in a fourth the serum alone and with albumin, placenta, and carcinoma gave positive results. Among 21 cases of abortion the diagnosis was specific in 11.

In the negative cases microscopic examination did not show any placental tissue capable of functioning. Among 27 cases of carcinoma 15 reacted positively with carcinoma only; the others showed positive reactions also with placenta or other forms of tumor. The reason for these rather unsatisfactory results may be that the authors did not have any metastatic carcinoma of the cervix available for substrates. Among the 21 cases of myoma the reaction was specific in 11. The substrate in these cases was a myofibroma with a moderate content of muscle-fibers. Because of the histological differences in the myomata examined, the results were not uniform in all cases. In one case placenta was catabolized and in another carcinoma. Among 5 cases of hæmorrhage in young girls, the ovary was the only substrate digested in 4 cases. Tables

are given showing the results in all these groups and a fifth and sixth table showing results in various gynecological conditions, and with male sera.

The results are not ideal but the failures, such as they are, seem to be due to errors in technique. The Abderhalden reaction is very delicate, so that the interpretation of the results offers some difficulty. The results seem to prove the correctness of the theory, if the details of the test are carried out with sufficient care. Errors may be caused either by the dialyzers or by the substrates. The latter are seldom completely freed of blood. It would be desirable to find some substitute for the ninhydrin reaction. The subjective element should be eliminated as far as possible, for the diagnosis may depend on slight differences in tints. Future work should be devoted to perfecting the reaction and overcoming the sources of error. A. Goss.

Steiner, H.: Abderhalden's Dialysis (Klinische Studien mit Abderhaldenschen Dialysierverfahren). *Deutsche med. Wchnschr.*, 1915, xli, 489, 526.

Steiner reviews the work of a considerable number of authors and gives tables showing his own results. He concludes that the method has a considerable value in diagnosis, but that its importance may be exaggerated. If menstruation can be excluded, a positive reaction with placenta justifies a diagnosis of pregnancy. A negative result is conclusive as to the absence of pregnancy. The results have just about the same value in diagnosing diseases of the organs of internal secretion. A definite diagnosis should be made, however, only in connection with the clinical symptoms, because in a disease of one organ the serum generally catabolizes several organs; this is due to their close interrelation.

The most favorable field for the use of the reaction is in diseases of the thyroid. The test is not so reliable in liver diseases, for the serum itself in cases of icterus contains substances that react with ninhydrin.

The author has not had sufficient experience with carcinoma to enable him to pass judgment as to its value in this condition. The principle of the reaction seems to be correct, and the clinician should make use of it in diagnosis, but further development in the technique is necessary in order to overcome certain sources of error. A. Goss.

Ottò, R., and Blumenthal, G.: Abderhalden's Dialysis (Erfahrungen mit dem Abderhaldenschen Dialysierverfahren). *Ztschr. f. Immunitätsforsch.*, 1915, xxiv, 12.

The authors described their technique and give in tabulated form the results of their work in several series of cases, including pregnant and non-pregnant women, patients with carcinoma, syphilis, dementia præcox, and various other forms of mental disease. They find that the serum of pregnant women practically always catabolizes placenta. If the reaction is negative it is almost certain that pregnancy does not exist; but a positive reaction does not speak with equal certainty for pregnancy, because the serum of carcinoma patients in all their cases gave a positive reaction with placenta. There is also a high percentage of positive reactions in syphilis.

The serum of men with dementia præcox gives a positive reaction regularly with testis and often with brain, but it also often gives a positive reaction with placenta. Testicle tissue is also frequently catabolized by the sera of patients with some other forms of mental disease, and also by that of pregnant women; so that, while there is undoubtedly a difference in the reaction in normal people and those with various forms of disease, the authors do not believe in the organic specificity of the ferments as described by Abderhalden. They believe from clinical experience and animal experimentation that there are various ferments in the body that do not have any organic specificity, and the action of the specific ferments may be masked by that of these non-specific substances. They think the Abderhalden reaction is not to be recommended for practice because of this lack of specificity of the ferments and also because of the many sources of error in the reaction itself; in addition to the difficulty in preparing the substrates and keeping the dialyzers in proper condition there are various substances that give a ninhydrin reaction.

A. Goss.

Blumenthal, N.: Theory and Diagnostic Value of the Meiostagmin Reaction (Diagnostische Verwertbarkeit und Theorie der Meiostagminreaktion). *Ztschr. f. Immunitätsforsch.*, 1915, xxiv, 42.

Blumenthal gives an exhaustive discussion of the theory of the meiostagmin reaction, first applied by Ascoli to the differentiation of pathological and normal sera. The surface tension is decreased and therefore the number of drops to the cubic centimeter are increased in the pathological sera as compared with the normal ones. Three theories have been advanced to explain the reaction. It may be due: (1) to chemical changes, such as increase of the lipoids, especially the fatty acids, and decrease in the contents of cholesterin and similar substances; changes in the quantitative and qualitative composition of the albumin, especially albumins and globulins, and their products, peptones and albumoses; (2) to physicochemical changes, such as changes in the concentration of OH and H-ions, and changes in the power of absorbing and combining acids and bases; or (3) to physical changes, such as decrease in the adhesive power of the individual components, which may be produced by pathological conditions, carcinoma, etc., or artificially by heating, shaking, etc. Blumenthal is inclined to believe that the latter theory is the correct one. He found a combination of linoleic and ricinoleic acids much better as an antigen than the tissue extracts first used. It is more stable, more easily prepared, and produces a greater reaction.

The reaction is not increased by the addition of cholin or lecithin.

As to its clinical usefulness, he found it valuable in the differential diagnosis of carcinomata of the gastro-intestinal tract, and in the diagnosis of pregnancy in perfectly normal women. It is of only limited value in the diagnosis of carcinoma of the female genital tract, and of no value in carcinoma of the liver or skin. In order to make a positive diagnosis of carcinoma or of pregnancy the following conditions, which also give positive reactions, must be excluded: diabetes mellitus, uræmia, infectious diseases with fever, severe tuberculosis, chronic inflammations of bones and joints, cirrhosis of the liver, and sometimes syphilis and sarcoma.

A bibliography of 122 titles is given, and also tables showing results in a large number of cases.

A. Goss.

Levin, I., and Van Slyke, D. D.: Results of Applying a Quantitative Method to the Abderhalden Serum Test for Cancer. *J. Am. M. Ass.*, 1915, lxv, 945.

The authors used a quantitative method of estimation of the proteolytic activity of a serum by measuring the ammonia nitrogen increase after the serum had acted on the given substrate. Controls were made with serum alone and with serum from normal individuals. A parallel series of experiments was performed using the dialysis method.

The results of the experiments using the two methods did not seem to coincide. In general there was little difference between the reactions obtained from the blood serums of the carcinoma cases from those obtained from the non-cancer sera. The authors, therefore, believe that the reaction is of doubtful clinical value and for the present at least the Abderhalden cancer reaction belongs to the research laboratory.

F. H. Falls.

BLOOD

Buerger, L.: Notes on the Technique of Transfusion. *Internat. J. Surg.*, 1915, xxviii, 299.

The author briefly describes the technique of blood transfusion by means of a syringe and two special cannulæ.

The veins in the recipient's and donor's arms are exposed by a 1-cm. incision and the cannulæ is inserted and fastened by ligatures. These are kept patent by salt solution and the escape of blood is prevented by compression of the rubber tube attached to each cannulæ.

The blood is slowly withdrawn from the donor into a "record" syringe which is passed to an assistant who gradually injects the blood into the recipient's vein. This is continued until sufficient blood is obtained.

The advantages are:

1. Cannulæ are easily inserted and remain *in situ.*

2. There is no clotting, as large tubes are employed.

3. An inexperienced assistant can be used at the recipient's side to inject the blood.

4. Loss of blood is prevented by the use of a short cannula with rubber coupling.

5. The cannulæ will not fail even in inexperienced hands.

Phillips M. Chase.

Percy, N. M.: A Simplified Method of Blood Transfusion, with Report of Six Cases of Pernicious Anæmia Treated by Massive Blood Transfusion and Splenectomy. *Surg., Gynec. & Obst.*, 1915, xxi, 360.

The author reports fifty-four blood transfusions effected by means of a one-piece, paraffine-lined, glass tube holding 650 ccm. of venous blood, protected from contact with air by a floating layer of sterile liquid paraffine. He describes a series of massive blood transfusions applied at intervals of ten days, to cases of severe pernicious anæmia, until they were so improved (temporarily) that splenectomy could safely be performed. He reports in detail, one case of three years' duration with evident cure eighteen months after splenectomy, showing a rise in erythrocytes from 868,000 per ccm. to 5,200,000 and a change in the blood picture from a typical pernicious anæmia to perfectly normal. He reports 5 additional cases with the same apparent result two months after step-ladder transfusions and splenectomy.

The signs and symptoms of fatal hæmolysis are described, the cardinal signs being: vomiting, respiratory distress, pain low in the back, and a characteristic blush and profuse sweating, followed by pronounced chills and suppression of urine. Death occurred in three weeks.

Percy finds that the tests for hæmolysis *in vitro* and agglutination, as described by Rous and Turner, are not dependable, and he gives a preliminary transfusion of 20 ccm. of blood intravenously, by hypodermic syringe, believing that this amount of blood will indicate hæmolytic phenomena without serious sequelæ.

The advantages of his method are:

1. Known quantities of blood may be administered.

2. As much as 600 ccm. can be given in five to eight minutes.

3. Venous blood is utilized, so that arteries, such as the radial, are not destroyed.

4. Transfusion may be made without contaminating the donor with the blood of the recipient.

5. No air comes in contact with the blood, thus lessening the liability of clotting.

6. There is direct communication between vein and chamber by a simple paraffin-lined glass tube. There are no metal, rubber, or other connections, whose edges cause resistance to the flow of blood.

7. The apparatus is simple and can be made by any good glassblower.

BLOOD AND LYMPH VESSELS

Zahradnický: Treatment of False Aneurisms (Die Behandlung der unechten Aneurysmen). *Wien. klin. Wchnschr.*, 1915, xxviii, 999.

The author reviews the literature of aneurisms during the Balkan War and the present war so far as he has been able to obtain it. He gives a table showing the method of operation and the results in 425 cases, and also an extensive bibliography of the subject. These 425 cases were reported by 45 different authors. Ligation was used in 242 of them and 182 were treated by suture of the arteries. Among the 242 treated by ligation, gangrene developed in 28, or 11.5 per cent, and necessitated amputation. Among the 182 cases treated by suture, gangrene made amputation necessary in 7, or 3.7 per cent. The mortality by the two methods was about the same, 7.4 and 7.1 per cent. But the figures show that ligation is followed by gangrene three times as often as suture of the vessels. Still better results could be obtained with suture if the advice were followed of several prominent authors who advocate early operation before adhesions have formed, and when there is not so great a tendency to thrombosis.

Zahradnicky also reports 52 cases of aneurism of his own, 49 of which were operated on and 3 recovered spontaneously. Of the operated cases 28 were treated by ligation, 1 by plication of the sac and 20 by suture. Among the 28 cases of ligation there were 6 of gangrene and amputation, or 21.4 per cent, 1 of superficial gangrene and 4 deaths from sepsis, or 14.2 per cent. Among the 20 cases of suture there were 2 of gangrene with amputation, or 14.2 per cent and 2 deaths, or 10 per cent. This confirms the results from the literature, that is, that gangrene is more frequent after ligation than after suture.

Ligation should be reserved for severe cases of sepsis or anæmia, where operation is necessary to save life, or for cases where the collateral circulation is already established and suture is unnecessary. In some cases where a considerable length of vessel must be removed the transplantation of a piece of vein becomes necessary. This is a difficult operation but such satisfactory results have been obtained with it that it is indicated in some cases. Two of the author's cases were treated in this way, one of them being successful and the other followed by gangrene. Lateral suture of the vein is a simple procedure and may be undertaken by any skilled surgeon, but circular suture and vein transplantation should be practiced experimentally on animals. They do not require any special instruments. The strength of the arterial suture is shown by the fact that adhesive plaster extension can be applied to the limb immediately afterward. Two of the author's cases were complicated with fracture of the femur, and he applied extension with a weight of 10 kg., without any bad results.

A. Goss.

Kahn, A.: Facilitating the Connection of Blood-Vessels. *Internat. J. Surg.*, 1915, xxviii, 315.

Kahn briefly describes the suturing of vessels by means of a divided cannula, devised by himself. The cannula being closed by a screw on the handle, is slipped over one end of the torn vessel which is then cuffed back over the end of the instrument, a ligature holding it in place. The other end of the vessel is then looped over this cuff and secured by another ligature, the first ligature then being cut. All clamps on the vessel are removed, the circulation resumed, and the two divided ends are directly sutured. The second ligature is severed and the cannula removed from the vessel by spreading in two parts, leaving a reunited blood-channel.

Phillips M. Chase.

SURGICAL THERAPEUTICS

Anderes, E.: The Effect of Some Uterine Tonics on the Circulation, Especially the Lesser Circulation (Über die Wirkung einiger Uterustonika auf die Zirkulation mit spezieller Berücksichtigung des kleinen Kreislaufes). *Arch. f. Gynäk.*, 1915, civ, 103.

The following chemically pure bodies can be isolated from ergot: (1) the alkaloid ergotin and (2) the amins, β-oxyphenylethylamine, β-imidazolethylamine, iso-amylamine, and phenylethylamine. Some of these are sold in trade as substitutes for ergot, either alone or in combination. The author tested the effect of these preparations on the circulation, especially the lesser circulation. He found that when ergotoxin is injected intravenously it does not cause a pronounced rise in blood-pressure, as the English authors Barger and Dale found, but a slight fall. He explains the difference by the fact that the Englishmen worked with animals that had had their brains removed, while the nervous system of his animals was intact. There was no change in the lesser circulation with small doses, while with large doses there was a slight vasoconstriction, which is the primary effect of the ergotoxin on the vasoconstrictors of the vessels of the lungs.

β-oxyphenylethylamine causes a slow and constant rise in blood-pressure, while the pressure in the pulmonary rises at the same time. The pulse becomes slower. β-imidazolethylamine has a very stimulating effect on the smooth muscles, but it is decidedly toxic. The blood-pressure sinks markedly and there is a diminution of the heart's force. In about 10 to 15 seconds after the intravenous injection there is a rapid and decided fall in the pressure in the pulmonary and a rapid fall in the plethysmogram. This effect is to be attributed to the vasoconstrictors of the vessels of the lungs. The bronchial pressure is not changed, so it does not have the effect of constricting the bronchioles. Iso-amylamine and phenylethylamine have practically no effect on the blood-pressure.

From the different effects of these substances it can be seen that the effect of preparations of ergot

must be very complex. In general immediately after injection there is a slight rise in blood-pressure, followed by a greater fall, and a secondary rise in the pulmonary, with a slight decrease in the pulse-count. The fall in blood-pressure is to be attributed to the β-imidazolethylamine, the slowing of the pulse to the other amins.

The chemically pure synthetic ergot preparations should be so compounded that the total effect does not produce either a pronounced fall or a pronounced rise in the blood-pressure. Heretofore, in making the preparations no attention has been paid to their effect on the lesser circulation. The author found that ernutin caused a slight rise in the pulmonary while the plethysmogram also showed a slight rise. Tenosin corresponds to the combined effect of β-imidazolethylamine and β-oxyphenylethylamine, of which it consists. There is no change in the carotid curve, while the pressure in the pulmonary rises.

Adrenalin causes a rise in the pulmonary pressure and an increase in the variations and the volume of the plethysmogram of the lungs, caused chiefly by an increased flow to the right heart; that is, it is secondary. There is no reason to assume a specific effect on the vessels of the lungs. Pituitrin increases the blood-pressure and has no effect on the lesser circulation.

The toxic properties of β-imidazolethylamine make it necessary to exercise great caution in its use. Though tenosin does not produce any dangerous symptoms, it should be used cautiously because of the effect it produces on the lesser circulation, for there are some individuals who are especially sensitive to β-imidiazolethylamine. From the point of view discussed ernutin seems to be a very good ergot preparation. After the administration of ergot, adrenalin should not be given, but extract of hypophysis and β-oxyphenylethylamine may be given. A. Goss.

Dakin, H. D.: Use of Certain Antiseptic Substances in the Treatment of Infected Wounds (Au sujet de l'emploi de certaines substances antiseptiques dans le traitement des plaies infectées). *Presse méd.*, 1915, xxiii, 377.

Dakin points out the disadvantages of various antiseptics in common use, including phenol, bichloride of mercury, iodine, nitrate of silver, etc. Sodium hypochlorite has a high germicidal power and other useful properties, but as obtained in commerce it contains free alkali, which has a very irritant action on the tissues. He has found that it can be rendered neutral by the addition of boric acid, thus preserving its high antiseptic property and overcoming its irritant properties.

The solution can be simply prepared as follows: 140 gm. of dry sodium carbonate, or 400 gm. of the crystallized salt, are dissolved in 10 liters of water, and 200 gm. of calcium chloride of good quality are added. The mixture is shaken and at the end of half an hour the clear liquid is siphoned off from the precipitated calcium carbonate and filtered through cotton. Forty grams of boric acid is then added to the liquid and the solution is ready for use. It is important to add the boric acid after filtration, not before. The solution will not keep more than a week.

The best results are obtained by continuous irrigation of the wound with the solution, the results of course being better if treatment is begun early. The solution aids in the dissolution of necrotic tissue and has a slight hæmostatic action. There is no irritant action at all, and experience with it for six months has demonstrated its value. A. Goss.

Carrel, A., Dakin, Daufresne, Dehelly, and Dumas. Abortive Treatment of Infection in Wounds (Traitement abortif de l'infection des plaies). *Presse mèd.*, 1915, xxiii, 397.

Tuffier has found that about 800 out of 1,000 amputations are not done on account of the gravity of the wound, but for the infection that follows it. This shows the great importance of preventing infection; prevention or abortion of infection is of infinitely more importance than treatment of its results, suppuration, septicæmia, and gangrene. Examination of the discharge from a wound five or six hours after it is made and again 24 hours later, show how much simpler early treatment is than later.

One point in abortive treatment of wounds is the early removal of foreign bodies. The wound should then be sterilized with some antiseptic that is strongly germicidal, not irritating to the tissues, and that is so applied as to penetrate all the recesses of the wound. After a comparative study of various antiseptics the authors have selected as the most effective and least irritating sodium hypochlorite prepared by Dakin's method. After the wound has been thoroughly cleansed, foreign bodies and bits of bone removed gently with the fingers or forceps, and bleeding controlled, a loose dressing is applied, no impermeable substance ever being used. Rubber tubes are run down into all recesses of the wound and project out through the dressings. Dakin's fluid is poured into them every hour at first and less frequently later. Continuous irrigation is even better if possible. This fluid can be applied for days or even weeks without irritating the tissues. It should not be used with alcoho and should not be heated.

Needless to say it is of great importance that the ambulance service should be so organized that the wounded would be brought in for treatment as quickly as possible. Examination of a series of wounds at different stages should show rapid decrease of the bacterial count under this treatment. A. Goss.

Bürgi, E.: Magnesium as a Treatment for Tetanus and as a Narcotic (Das Magnesium als Mittel gegen Tetanus und als Narkotikum). *Jahresk. f. ärztl. Fortbild.*, 1915, vi, 3.

Bürgi gives an exhaustive discussion of the pharmacological properties of magnesium sulphate

and a bibliography of the literature on the subject. Animal experimentation has not shown definitely that this substance is a true narcotic, but clinical results show that it is. Painful ulcers are rendered painless by the local application of magnesium sulphate, and when it is given subcutaneously, intramuscularly, intravenously, or intraspinously it causes cessation of pain and loss of consciousness.

The chief clinical use of magnesium as a narcotic has been in the treatment of tetanus. Kocher reports excellent results in adults, but poor ones in children. He gives a 15 per cent solution intraspinously. The only danger than he can see is that of paralyzing the respiratory center, and this may be combated by the administration of calcium chloride, calcium being an antagonist of magnesium; by keeping the patient in the proper position and by the insufflation of air or oxygen into the bronchi. He recommends a repetition of the injection whenever convulsions begin again. The effect lasts 8 to 24 hours longer with the intraspinous method of injection than with any other and if sufficient care is taken there is little danger of injuring the respiratory center. Kocher gives an adult 10 ccm. of the 15 per cent solution, while Meltzer and Auer recommend 3 to 5 ccm. of a 25 per cent solution. This dosage may be repeated twice in 24 hours. Given oftener than that it may produce harmful cumulative effects.

Straub prefers intravenous administration. He found that the muscles that were in convulsions were paralyzed quicker than the normal ones, and that they were not completely paralyzed, but only reduced to normal activity.

Stadler has given a series of statistics showing the marked reduction in mortality after magnesium sulphate treatment, but Bürgi does not think these statistics are valid, because they do not extend over a large enough number of cases. He is convinced, however, that the magnesium treatment is effective. It not only prolongs life but may save it, for one of the causes of death is exhaustion from the repeated convulsions. Further work needs to be done in regard to the comparative value of the different methods of administration. A. Goss.

ELECTROLOGY

Levin, I.: The Efficiency of the Coolidge Tube, and the Rationale of Radiotherapy in the Treatment of Malignant Tumors. *Surg., Gynec. & Obst.*, 1915, xxi, 374.

The author reports on an experimental study of the relative efficiency of the biological action of the röntgen rays emitted by the Coolidge and the old-type tubes. The results of experiments in radiation of pieces of meat of various thicknesses show that one-half of the quantity of the rays emitted by a Coolidge tube penetrate to the depth of 2 inches, while only one-third of the rays emitted by an old-type tube penetrates to the same depth. To the depth of 4 inches one-seventh of the rays penetrate from an old-type tube and one-fifth of the rays from a Coolidge tube. This greater efficiency of the Coolidge tube for purposes of therapy is due to the greater uniformity of the röntgen rays emitted by a Coolidge tube and a smaller admixture of soft non-penetrating rays.

The author reports 41 cases of deep-seated malignant tumors treated during the last eighteen months with the modern methods of radium and röntgen therapy. Of these cases, 13 died, 11 discontinued treatment, 14 remained unimproved, and 3, or 7.5 per cent of all the cases treated, are at present clinically cured.

A complete clinical and gross and microscopical post-mortem study is reported of a case of an inoperable carcinoma of the sigmoid with a carcinomatous dissemination in the peritoneal cavity, which died over a month after the beginning of röntgen treatment. The study of this case shows the following points of importance: notwithstanding the continuously very large doses of röntgen rays, there was no injury to the organism. At the same time the majority of the islands of tumor-cells in the peritoneal nodules were either completely destroyed and replaced by dense fibrous connective tissue or were surrounded by the connective tissue and inhibited greatly in their growth. The original sigmoid tumors did not increase in size during the time of treatment.

The author further compares his results with the reports of other clinicians. The analysis of 1,002 cases of deep-seated inoperable malignant tumors shows that 6.7 per cent of these cases were clinically cured. The author concludes that the therapeutic action of the actinic rays is not entirely local. The rays may destroy cancer-cells at a considerable distance from the source of the rays; but the farther the distance of the tumor from the surface of the body, the smaller its size must be in order to be destroyed by the rays.

MILITARY SURGERY

Leriche, R.: Non-penetrating Injuries of the Skull by the Bursting of Shells, and the Nervous Lesions Caused by Them (Des petites plaies du crâne par éclats d'obus et de bombes sans pénétration du projectile et des lésions nerveuses qui les accompagnent). *Lyon chir.*, 1915, xii, 293.

Leriche gives an extensive study of the subject, reporting the details of 87 cases of skull injury and 11 others in which there was no direct wound but only severe concussion of the brain or spinal cord from explosion of shells or mines. He has seen 397 cases in which the fragment of shell had apparently only bruised the scalp. But no matter how slight the wound appears to be an exploratory incision should be made in every case, and if the bone looks at all abnormal it should be trephined; but if the dura is found intact it should never be incised, no matter how severe the subjacent hæmatoma and contusion of the brain may be. High pressure in the spinal

fluid does not distinguish between deep-seated and superficial lesions. Leriche was inclined to believe that it did at first, but has tested it thoroughly and found that it did not. High pressure and an abnormal tint of the fluid indicate the existence of small foci of contusion of the brain, due to air concussion from the explosion of the shell, rather than to the effect of the projectile itself. Lumbar puncture is of great value in treatment.

In the cases caused by concussion the pressure of the spinal fluid remains high for days if puncture is not performed, and the patients show paralytic phenomena or melancholia with stupor or Jacksonian epilepsy. Œdema of the brain and hæmorrhagic foci were found on trephining, and lumbar puncture gave great relief. A. Goss.

Tartois: Thirty-four Penetrating Wounds of the Abdomen Treated at the Front (Trente-quatre plaies pénétrantes de l'abdomen traitées dans une ambulance divisionnaire du front). *Bull. et mém. Soc. de chir. de Par.*, 1915, xli, 1937.

Tartois gives the clinical histories of his cases, and divides them into three series. Of 8 treated conservatively, all died; of 15 treated by suprapubic incision and drainage, only 3 recovered, or 20 per cent. He then decided to perform laparotomy and give thorough surgical treatment. Of 11 cases treated in this way 5 recovered, or 45 per cent. As these operations were performed by the same surgeon and under similar conditions they offer conclusive evidence of the superiority of surgical treatment.

Tartois was in an improvised hospital very near the firing line, where he was "surgeon, interne, externe, and nurse," and besides the multiplicity of his duties his equipment was very incomplete. This situation, however, had one advantage that he got his patients very soon after they were wounded; the operations were performed not more than eight hours after injury. In the Balkan War he was in the Turkish Red Cross service, and at that time he believed in the conservative treatment of abdominal injuries, but this later experience has convinced him of the superiority of surgical treatment, even when it has to be performed under quite unfavorable conditions. A. Goss.

Enderlen and Sauerbruch: Operative Treatment of Abdominal Wounds in War. *Med. Klin.*, Berl., 1915, xi, No. 30.

The authors recommend prompt operative interference in abdominal wounds involving the gastro-intestinal tract. They treated 227 soldiers for gunshot of the abdomen. They operated on 211; of these 92.9 per cent exhibited gastro-intestinal perforation; in 4.8 per cent there was no intestinal nor visceral lesion, while 2.2 per cent suffered severe injury to the liver. Operative treatment cured 44.4 per cent of the 221 operated upon. Of the 5 cases sustaining injury to the liver, 3 or 60 per cent recovered under operation.

Experience in abdominal work enabled the authors to give accurate diagnoses so that the later groups of cases showed better results from earlier operative interference. Transport facilities have improved with the progress of the war so that the injured are now brought to field hospitals in from two to four hours from the time of injury. Direct transfusion of blood is no longer recommended. Infusion by the drop method has given good results.

As to the preference of the lying or sitting posture in convalescence, the latter was practiced by Enderlen and the former by Sauerbruch, with no material difference in the outcome. The value of heat applied to the abdomen in post-operative cases was proved by both authors. Early feeding was practiced in all operated cases, and quiet after operation was insisted upon.

Concerning the difficulty of determining abdominal perforation early, the authors call attention to costal respiration which they consider of the greatest importance in determining the presence of intestinal lesion. Prompt operation is called for when the surgeon has reason to believe that hæmorrhage is taking place. Louis A. Lagarde.

Horn: Treatment of Fractures of the Femur in the Field (Beitrag zur Behandlung der Oberschenkelschussbrüche im Felde). *Ztschr. f. ärztl. Fortbild.*, 1915, xii, 490.

It has been the almost universal custom to dress all fractures in the field with plaster casts, because it has been thought impossible to transport them in adhesive plaster extension. Horn thinks it is quite right to apply the plaster cast in cases where the fractured ends can be brought into proper position, where the condition of the wound is such that it can be dressed through a fenestrated cast, and where there is no extensive infectious process and danger of secondary bleeding. But if the displacement is so great that correct replacement is difficult or impossible, if the wound is severely infected, or if plaster is not available, as sometimes happens, adhesive plaster extension can be applied to fractures and they can be thus safely transported. He himself has attended to the transportation of a number of cases and they have arrived at the base hospital in good condition without pain or displacement of the fractured bones. He describes a stretcher designed for this purpose, provided with an extension apparatus, which folds up so that it is no larger than an ordinary stretcher. A. Goss.

Leva, J.: Injuries of the Spinal Cord in War (Über Verletzungen des Rückenmarks im Kriege). *München. med. Wchnschr.*, 1915, lxii, 925.

In 9 of the cases observed by Leva, symptoms of complete transverse lesion predominated; in 5 there were signs of a lesion of one half of the cord, and in 7 signs that indicated solitary injuries of different centers. Of the patients with signs of a total transverse lesion 2 died soon after they were received, 1 of an ascending meningitis and 1 of pyelonephritis;

the condition of 1 remained unchanged, in 1 the symptoms gradually improved till they were those of a unilateral lesion, in 2 a spastic paralysis developed, and 3 improved so much that no organic symptoms remained except increased reflexes.

These cases show that symptoms of a complete transverse lesion at first do not by any means prove that there is actually a complete severing of the cord. Shock and concussion have caused a temporary cessation of its function, which is restored in time.

Of the 5 patients with unilateral symptoms 2 improved markedly, while the paralysis only improved slightly in the other 2. In the other cases the course varied; in 1 it was very favorable, 2 developed cerebellar symptoms, 1 developed pain and atrophy of the right arm, which did not improve much even after laminectomy. In 2 cases of injury of the neck signs of lesion of the medulla developed, including various subjective symptoms and paresthesias. Injuries of the cervical column did not produce such serious effects as injuries lower down. The total of 21 cases after six months' observation shows 2 deaths, or 9.5 per cent, but they cannot be regarded as closed, for secondary signs of degeneration often appear a long time after the injury. A. Goss.

Baumel, J.: Lumbar Puncture in Nervous Shock and Wounds of the Skull in War (La ponction lombaire dans les commotions nerveuses et les traumatismes du crâne par projectiles de guerre). *Lyon chir.*, 1915, xii, 271.

Baumel has had occasion to examine the cerebrospinal fluid in a large number of cases during the war and he gives a table showing in detail the results in 56 cases. The condition of the spinal fluid gives important information as to the extent and severity of the injury. It is also of considerable value in treatment, for he finds that the pressure of the spinal fluid is above normal, even in cases of mere concussion where the projectiles have not come into direct contact with the skull. Nearly all the wounds reported were from fragments of shells.

If the spinal fluid shows an increase in the polynuclear count it means a more serious prognosis, for polynucleosis is an index of infection. When there is only lymphocytosis, the meningitis is subacute. Lumbar puncture is the only rational form of treatment in simple disturbance of the nervous system and in non-penetrating wounds of the skull. It is valuable also in cases of severe injury of the skull as it reduces the symptoms caused by high pressure, rids the system of toxins, and hastens recovery. It should be performed systematically day after day as long as it is doing good, for it is absolutely harmless. A. Goss.

Stargardt, K., and Kirschener: English Bullet Wounds; Some Remarks on the Action of the Regular Infantry Bullet and the Dumdum Bullet. *J. Roy. Army M. Corps*, 1915, June, 601.

Stargardt confines himself to the appearance of the wounds caused by the English infantry bullet and some wounds inflicted by the French infantry bullets, all coming from the western front. The two groups of wounded showed a striking difference in both their clinical and characteristic features. The wounds inflicted by the French infantry bullet were not as a rule very severe and were generally attended by a favorable prognosis.

The wounds caused by the English infantry bullet were generally more severe; bones were more fragmented, the vessels and nerves more frequently hit, muscles much more extensively torn, than was the case when wounds were inflicted with the French infantry bullet. The severe bone lesions from the English bullet often exhibited extensive wounds of exit, which were at times erroneously thought to be the result of wounds inflicted by dumdum bullets. These large exit wounds were often seen in similar injuries by the French bullet when the latter had turned in the body.

The X-ray pictures of bone injuries by the English bullet exhibit a greater area in the wounded part with many fragments of metal, so much so, that the lesion resembles that of lead fragments from shrapnel balls. In cutting down upon this area, however, fragments of the infantry bullet were almost invariably identified. The greatest significance was attached to the fact that the broken up bullet contained two distinct cores. A dissection of the English bullet showed that the core was made up of two different metals, the forward core measuring 11 millimeters in length composed of a lighter aluminum metal, and a rear core 20 millimeters in length composed of the heavier lead metal, separated from the forward core by a narrow line of demarkation. Stargardt is fully convinced that the special construction of this bullet exercises an explosive action on striking resistant structures, since it disintegrates more easily at the moment of impact than the normal bullet which is filled with a hard lead core. He claims further that he has not in a single case extracted a lodged ball from the English infantry rifle that was not deformed. He makes the accusation boldly that the English infantry bullet is manufactured with the idea of wounding and mutilating the enemy which it may strike. Outwardly the bullet is harmless looking, showing none of the marring effects that are practiced on the steel coating to promote deformation and thereby convert it into a dumdum bullet. He makes the claim, however, that in some cases the point of the bullet has been broken off by the enemy before firing by placing the point in a vice which is provided in the stock of the English rifle, but he maintains that this marring of the bullet is not necessary since the bullet with the point intact will exercise an explosive effect on striking

Kirschener's remarks on the action of the regular infantry bullet and the dumdum bullet deal with the construction of the bullets, the action of the regular infantry bullets, the occasional abnormalities of the shape and position of the regular bullet, the action of the regular infantry bullet when its

position and shape have been altered, and the action of the dumdum bullet.

The construction of bullets is discussed under two heads: the steel mantle bullets filled with a core of lead or lighter metal, and the solid bullets made of one material. The mantle bullets are those used by all the armies engaged in the present European War, except the French, who use a bullet made of a solid mass of bronze (90 per cent copper).

The dumdum bullet is described as a modification of the mantle bullet in which the steel coating is incomplete at the front end so that the lead core is exposed to view. This is usually accomplished by breaking off the point in a vice, filing or sawing down to or through the lead core thus inviting the tendency to fragmentation on impact against hard bone. The marred jacket of the bullet is at times smoothed over by filling the gap with a metal, like aluminum, so that the character of the bullet is not apparent on inspection. This is the device sometimes resorted to in factories that make ammunition for sporting purposes. A soldier, if he so chooses, can convert a regular steel-clad bullet into a dumdum projectile by the use of a file, saw, gimlet, etc., in a few minutes. This is not possible with the French bullet which is made of one solid piece of metal.

The action of the regular infantry bullet on regular impact through soft tissues and spongy bone is to inflict a cylindrical channel about the size of its own diameter, with correspondingly small wounds of entrance and exit in the skin. If the remaining velocity of the bullet is great and the bullet encounters hard bone, the latter is very much shattered and the amount of shattering effect is inversely proportional to the distance traveled by the bullet. The shattering effects within 400 meters by all the normal steel-mantled bullets are so great that the area of fracture is said to possess the appearance created by an explosion at the point of impact — splinters of bone varying in size are detached and scattered broadcast in the neighboring tissues. At very close range gaps occur in the continuity of the bone, one and two inches in length. The soft tissues are very much lacerated, and hæmatomata fill the channels made by the spiculæ of bone which are lodged in different directions. The point of exit is often marked by a large wound measuring several inches in diameter, whilst the wound of entry is small. When the projectile strikes a part of the body enclosed by a rigid wall containing a fluid or semifluid mass like the skull, the explosive effects in the proximal ranges are enormous. Organs like the stomach, the intestines, bladder, and other viscera containing fluids are very much lacerated by shots at close range.

In discussing the occasional abnormalities of the shape and position of the regular bullet the author points out the well-known fact that the center of gravity of the infantry bullet is well disposed toward its base, since it tapers from near the base to the point. This is specially true of the spitze bullet first adopted by the German army. The bullet is thereby made unsteady in flight with a tendency to rotate on its short axis. This altered position to the line of flight may cause the bullet to strike the body side or base on or in an intermediate position. The altered position of the bullet may be exaggerated in ricochet and when the article which it strikes is resistant, like a rock or piece of metal, the shape of the bullet may thus be materially altered.

The turning of the bullet in the latter end of its trajectory is common, so that lodged balls in wounds inflicted in the remote ranges are usually found to be butt-end-to.

When the regular infantry bullet has changed its position or shape in the ways mentioned the characteristic features of the wound vary from those of the normally shaped bullet when it makes a regular impact. Thus, a bullet striking side-on will cause greater laceration of soft tissues and fragmentation of bone, and the same is true when the bullet has suffered deformation from any cause. In addition, a bullet which strikes a resistant bone side-on when traveling at great velocity is apt to disintegrate by first losing some of the lead core which is exposed at the base. This disintegration will of course be more commonly seen in bullets that have primarily been altered in shape by ricochet. The appearance of the wounds thus caused are so much like those inflicted by a dumdum bullet that it is difficult if not impossible to distinguish between the two. The French bullet is not so easily distorted in ricochet or on striking hard bone, nor does it disintegrate and lacerate tissues by the escape of a metal core since it is made up of one solid piece of metal.

In describing the action of the dumdum bullet the well-known fact that it does not disintegrate while traversing soft tissues only is especially emphasized. In order that the dumdum bullet shall break up in the way that it is designed to do, it must collide while traveling at a fair rate of velocity against resistant bone, otherwise its effects are very similar to a full jacketed or old time lead bullet.

In summing up his conclusions Kirschener maintains that conclusive evidence that a wound has been inflicted by a dumdum bullet is the recovery of the projectile in its original shape or slightly deformed. Extensive destruction of the tissues affords no proof of the use of a dumdum bullet, since like lesions are common with the normal bullet striking sideways and also when the shot is delivered at short range against resistant structures like the skull, the diaphyses, and organs filled with fluid or semifluid masses, like the stomach, the intestines, and urinary bladder. The fact that pieces of the steel casing and the lead core are found in the area of fracture is no evidence of the use of a dumdum bullet, since this occurrence is often noted from the use of the steel-mantle projectile. Such breaking up of a normal bullet applies to the infantry rifle ammunition of all the armies except the French. The latter cannot be transformed into a dumdum bullet as already noted.

In commenting upon the papers of Stargardt and Kirschener, PILCHER notes that the Germans were the first to adopt the pointed or spitze bullet. That this very unstable bullet would inflict wounds having the character of those from dumdum bullets was early pointed out by the German military surgeons after experiments on cadavers and living animals, and this fact is daily corroborated by the English surgeons in their treatment of war wounds.

With the use of the ogival-headed, bullet of the reduced caliber rifle of 6 to 8 millimeters which preceded the use of the spitze bullet, there was a loss of wounding power in soft parts, epiphyseal ends of bones, and the diaphyses at certain ranges. This loss of wounding power was due to the small striking area of the bullet. To increase the wounding power it was necessary to resort to the use of expanding or dumdum bullets, which as everybody knows are ruled out in civilized warfare by international agreement, but Pilcher maintains that the Germans who invented the pointed bullet achieved the same end by adding instability to the military bullet, which gives it in effect all the characteristics of a dumdum bullet in the creation of wounds. To make a long story short, he dismisses the unfair charge made against the English for the use of the lighter metal of the core near the tip of their bullet by the following explanation: "The device in construction of the bullet with two cores renders the tip of the English bullet considerably lighter than the cylindrical part farther back, and consequently the center of gravity of the whole bullet is thrown nearer the base than is found in the lead core bullet of the Germans. This fact makes the tendency to turn on impact considerably more marked than if the whole core were of one metal." In his opinion there is no appreciable difference in severity between the wounds inflicted by the German and English bullets. They are equally severe and it is quite apparent that we have gone back to the exaggerated type of wounds inflicted at short ranges by the large leaden bullets of the "Brown Bess days," and they occur at vastly increased ranges and therefore in greater numbers, and he adds further that "the nation which first introduced the pointed bullet is responsible for thus turning the flank of an international agreement, as it is obvious that its example must necessarily and in self-defense be followed by all the other nations."

The reviewer of the foregoing controversy desires to make the following comment in justice to all concerned:

1. The Germans, as we understand it, did not designedly adopt the pointed bullet for the purpose of inflicting unnecessarily cruel wounds. All the nations that have adopted this bullet—Germany, England, the United States, Turkey, and France—did so because the pointed missile offers less resistance to the air which enables it to travel longer in a straight line than the round-nose bullets.

This fact has added very much to the continuous danger space, and for that reason tactitians have favored it to the exclusion of other projectiles. The projectile used by the United States Army, which is very much like the German bullet, has a continuous danger space of 718 yards for the ogival-headed bullet of the Krag-Jorgenson and Mauser rifle bullets.

2. In the same way it is unfair to accuse the English of using a double core to add to the severity of wounds. The change in their ammunition was the result of experiments which they made in an endeavor to lengthen their bullet so as to give it more bearing surface in the barrel and thereby make it more steady in flight. By lengthening the bullet with the lead core they added weight to their ammunition, which is very objectionable to tacticians in these days of rapid-fire guns. In order to overcome this objection in their longer bullet they substituted aluminum for the lead tip of the core. It is doubtful if this bullet more readily undergoes deformation than bullets having single lead cores. It is barely possible that the existing separation of the two cores in the English bullet favors fragment more readily when striking resistant structures at high velocity. The increased amount of fragmentation can only be a shade in difference and when we consider that the instability of the two bullets is equally objectionable, we see but few reasons if any for accusations and recriminations.

3. In spite of the fact that pointed bullets are unsteady and prone to make irregular impact, from a number of causes, and thereby increase the severity of wounds, the fact nevertheless remains, that a large percentage of wounded go back to the colors in an incredibly short space of time. Furthermore, we are told that the ratio of killed to wounded is variously stated to be as one to five and as much as one to ten. A recent report from Germany declares that 90 per cent of the wounded are returned to the colors. The character of the wounds and the ratio of killed to wounded largely depend on the armament used and the kind of fighting. Battles in the open with a preponderating rate of military rifle fire at the usual battle ranges would give a majority of light wounds with a less number of killed to wounded; whereas trench fighting at close range with hand grenades, machine guns, and shrapnel would add to the percentage of casualties for the number of troops engaged, and add to the number of killed to wounded. In a recent letter Sir William Osler states that in the first ten months of the war sixty per cent of the British wounded were restored to duty.

L. A. LAGARDE.

Tuffier: Early Disinfection of War Injuries (De la désinfection précoce des plaies de guerre). *Bull. Acad. de méd.*, Par., 1915, lxxiv, 314.

The importance of early disinfection of wounds is not sufficiently realized. Of 1,000 amputations

75 per cent were due to the long duration of the treatment of wounds and their late complications, such as neuritis, osteitis, and vicious scars. Disinfection after the first 48 hours is practically impossible, but disinfection within the first few hours is very effective.

The number of bacteria in a wound and their diffusion through the tissues are in proportion to the length of time that has passed since the wound was made. As early as the Russo-Turkish war of 1877, Reyher showed that in injury of the joint there was a mortality of only 13 per cent in the cases treated during the first 12 hours, while among those treated later the mortality was 61.5 per cent. The same thing was true of compound fractures, the mortality rising after the first twelve hours from 18.1 to 35.3 per cent.

The action of the antiseptics in use at present has been shown to be unsatisfactory. From his recent research work Wright thinks that hypertonic salt solution is the best, because of its osmotic action on certain elements of the serum, but it is powerless against the streptococcus. Tuffier believes that the best antiseptic to use is hypochlorite of soda prepared by Dakin's method.

All wounds should be disinfected at the dressing station or at the stationary ambulances, which are from 5 to 20 kilometers back from the firing line. At the dressing stations the skin is disinfected with ordinary petroleum, the superficial or easily accessible parts of the wound cleansed, and a compress of Dakin's solution applied and bandaged loosely. The wounded limb is immobilized. The line of stationary ambulances should form a barrier beyond which no infected case should be allowed to pass. The wounded should arrive there within 12 hours after being wounded, and the wounds be completely disinfected. It is very dangerous to send an infected case farther, and perfectly safe to send the patient on after immobilization and complete disinfection of the wound.

The technique is as follows: Combat shock, though no really satisfactory means is yet known for doing this. Take a radiogram to show the site of projectiles and the nature of fractures. Give ether anæsthesia if there is no contra-indication. Cleanse the skin and apply tincture of iodine, protecting the wound. The wound is then irrigated thoroughly with hypochlorite of soda, and the surgeon explores it very carefully with his finger or a probe; all foreign bodies and bone fragments are removed very carefully so as not to injure sound tissue. Any necessary incisions are made with care and only necrotic tissue removed. After the wound has been cleansed in this way several rubber tubes are inserted into its deepest recesses. If it is necessary in order to hold the wound open tampons of cotton wet with Dakin's solution are put in around the tubes. Sterile cotton is put all around the wound and the limb and very loosely bandaged, the rubber tubes projecting out through all the dressings. Every hour 5 to 10 ccm. of Dakin's fluid is poured into the tubes. The cotton is changed every day. A clear liquid is discharged from the wound at first, but there is no odor or suppuration. The temperature generally falls to normal within 48 hours. Tuffier intends to publish the statistics of his cases treated in this way soon. When the temperature has been normal for a few days and the wound is in perfect condition it is allowed to close up.

A. Goss.

Mixter, W. J.: Surgical Experiences in France. *Boston M. & S. J.*, 1915, clxxiii, 413.

A general description is given of Mrs. Whitney's hospital at Juilly, France, its equipment, the work handled, and the usual methods pursued.

The hospital, furnished and maintained by Mrs. Harry Payne Whitney, is located in one wing of an old Jesuit college at Juilly, which is about thirty miles from Paris towards Soissons, and thirty-five miles from the trenches. Compiègne is its distributing-point. Under the direction of Dr. Edward Martin the building has become a modern fully equipped hospital.

French wounded in the trenches receive first aid attention by the medical officer, and are carried back, when possible, to the dressing station. There the dressing is re-adjusted and the diagnosis tag attached. From there, they are sent to one of the first line hospitals or to the distributing-point, as seems advisable. There they are assigned to some local hospital or sent to Paris or southern France. Cases of penetrating wounds of the head, chest, or abdomen are kept near the front until able to travel, but most fractures and some of these serious cases are sent back from the first line hospitals.

The cases at Juilly are bullet fractures and severe wounds not involving the body cavities. Most of the wounds are due to shell or shrapnel, with about 15 per cent due to rifle balls and hand grenades.

The first class usually becomes septic, due to bits of clothing carried into tissues, hence the clothing of such is examined when possible. All cases are X-rayed or fluoroscoped. A moderate number show clinically the presence of gas bacillus, and Mixter believes 90 per cent of all this class of cases will show this bacillus, but in varying degrees of virulence. The suggestion of Hervey as to graded doses of direct sunlight has been used with decided benefit.

In fractures, especially of the femur, the Steinman pin was found most useful. No bone-plating was done. Traction was put on and fracture let alone unless sepsis developed, when the abscess was opened and drained.

Fractures of the long bones by rifle bullets usually remained clean. Tincture of iodine was painted on exit and entrance wounds and the cases treated as closed fractures. Retained rifle bullets were rarely removed, but large fragments of shell and shrapnel usually had to be taken out.

Wounds of the knee-joint were most common, and when septic almost always led to permanent dis-

ability or even death. Slight traction was used in all cases to alleviate the pain, and Carrel's suction drainage recommended.

The judgment of the French surgeons, both as to diagnosis and prognosis, is highly commended by the author. PHILLIPS M. CHASE.

Alder, A.: Hospital Experience in the Turko-Bulgarian War (Etappenspitalerfahrungen in türkisch-bulgarischer Krieg). *Deutsche Ztschr. f. Chir.*, 1915, cxxxiii, 499.

Alder accompanied the Swiss Red Cross to Bulgaria during the Turko-Bulgarian war of 1913. He was stationed at Dimotika, south of Adrianople, where the courthouse had been converted into a hospital. The difficulties of the work were due chiefly to poor hygienic and sanitary conditions, the national peculiarities of the Bulgarians, and other conditions of general, rather than surgical interest. The bacteriological laboratory was established in a vacated Turkish harem, and many of the windows of the hospital were broken out, so that at night several centimeters of snow collected on the bed covers. As to the purely surgical side of the work he compares his experience with that of Brun, his chief, who is now head surgeon of a hospital in Strassburg.

It seems that there were much better results in the healing of wounds among the Bulgarians than among the French and German soldiers in Strassburg. Osteomyelitis, particularly, has been a much more frequent and severe complication of gunshot wounds among the latter than it was in the Bulgarian war, which leads Alder to question whether the western Europeans are less resistant to disease than their less cultured neighbors on the east. He had a total of 1,363 cases and a mortality of 10, or 0.7 per cent.

He thinks the soldiers' packets of dressings should contain some kind of adhesive plaster. In everyday life in Bulgaria tobacco is used as a hæmostatic, so it was often used during the war. He never punctures in case of hæmothorax. He advises against operation in abdominal injuries. The man wounded in war is much less resistant for the first few days than one wounded in peace. There is such a thing as "war shock," and operations should be delayed 12 to 24 hours. A. Goss.

EXPERIENCES OF GERMAN MILITARY SURGEONS

INJURIES TO THE SPINAL CORD

Michaelis, at a meeting of the *Verein für wissenschaftliche Heilkunde* of Königsberg,[1] reported the case of a patient wounded by a bullet, which inflicted a small wound of entry in the back of the neck, somewhat to the left of the middle line, and at the level of the fourth cervical vertebra. There was no wound of exit, though the lower jaw on the left side was badly shattered. A day after the infliction of the wound both arms and legs were paralyzed, but there was no paralysis of the bladder. The paralysis of the right arm and leg soon began to disappear, leaving only a slight weakness of the right arm. A skiagram showed slight injury to the fourth cervical vertebra at the junction of its body with its arch. Viewed from in front, the bullet could be seen lying behind the much shattered horizontal ramus of the left lower jaw. No active treatment was attempted during the first fortnight as it was hoped that the paralysis of the left arm and leg would disappear spontaneously. Treatment of the fractured vertebra by Glisson's extension apparatus was impracticable owing to the fracture of the jaw. The fragments were united by bronze wires, and the bullet was removed. As there was no improvement in the paralysis of the left side after a month, laminectomy was performed, on the assumption that the paralysis was due to pressure on the cord by a fragment of bone, or to peripachymeningitis, with local œdema of the cord. The arches of the third, fourth, and fifth cervical vertebræ were removed, but no loose fragment of bone could be found. There were, however, signs of peripachymeningitis. To the left of the middle line the dura was adherent to the fourth cervical vertebra over a small area. This adhesion was severed. After the dura had been opened, and a considerable quantity of cerebrospinal fluid had escaped, a narrow groove was seen passing across the cord from behind and to the left, forwards and outwards. This wound of the cord, which had been gouged by the bullet, was closed by catgut ligatures, passing upwards and downwards, so as to unite the upper and lower margins of the groove. The wound in the dura was then closed and the operation completed. Three days later the movements of the left big toe were regained, and during the following days the paralysis of the left leg gradually receded upwards. Eleven days after the operation there were active movements about the ankle, and three days later the patient could also move his legs slightly about the knee. Movements of the left arm did not begin to return till about four weeks after the operation, when first the thumb, then the fingers, and finally the rest of the arm began to regain the power of movement, the paralysis gradually receding upwards. Though the use of the left leg was almost completely restored, that of the arm remained much impaired. Michaelis, while insisting that the operation was very successful, admitted that the reason for this success was not perfectly clear. It might have been due to relief of pressure on the cord, which, in its turn, might be traced to the drainage of cerebrospinal fluid. The improvement might also have been largely due to the closing of the groove in the cord.

Leva[2] reports that he has often seen paralysis of the bladder and intestine, as well as sensory dis-

[1] Deutsche med. Wchnschr., 1915, July 8.

[2] Deutsche med. Wchnschr., 1915, July 8.

turbances, disappear spontaneously, and marked improvement in other symptoms occurs, even in cases in which there was evidence of complete transverse section of the cord (*vollständige Querschnittlaesion*). It was, therefore, unwise early in the case to diagnose total division of the cord, and to give an unfavorable prognosis. Brown-Séquard's unilateral lesion did not run such a favorable course as the total transverse lesion (*Querlaesion*). In some cases of injury to the cord there were only a few isolated symptoms. Thus, in one case in which certain nuclei of the medulla were involved, the symptoms were paralysis of the recurrent nerve, and unilateral atrophy of the tongue. In another case the symptoms consisted of difficulty in swallowing, loss of the patellar reflexes, and static-atactic manifestations. In a third case, weakness of the legs, diminution of the tendon reflexes, and diffuse sensory disturbances were observed.

Guleke said that he had come to the conclusion that it was often extremely difficult to learn the extent to which the cord had been injured, and that he was therefore in favor of early operation as a rule, for though this principle led to superfluous operations, it also saved the lives of many who would otherwise have died. He had performed 20 laminectomies, and in none had any harm been done. He did not advise this operation in cases complicated by severe pneumonia, meningitis, open and much infected wounds or "urosepsis." Hæmothorax, on the other hand, is no contra-indication, but when it is present the operation should be performed under local anæsthesia. In 10 of his cases the cord was conpletely crushed, and they all terminated fatally. In 5 other cases death was due to sepsis. There were, therefore, only 5 recoveries among his 20 cases; but he was certain that 3 of the patients who recovered would have died had not the operation been performed. In these 3 cases splinters of bone or bullets were found in the cord, which they had much injured.

DIAGNOSIS OF GAS PHLEGMON BY X-RAY

Early in 1915[1] Payr called attention to the imporrance of distinguishing between superficial and deep gas phlegmon. When it was subcutaneous, multiple superficial incisions were often sufficient, whereas when the gas phlegmon was deep-seated, extensive incisions were usually inadequate, and had, as a rule, to be followed by amputation. This view has recently[2] been endorsed by Professor M. Martens, who added that the relatively benign, superficial gas phlegmon was far less common than the malignant, deep-seated type. As far less radical treatment was necessary for the one than for the other, it was of the greatest importance to distinguish between the two; to amputate for superficial gas phlegmon on the supposition that the disease was deep seated was bad practice. In most cases the differential diagnosis could be made clinically or during an operation, but in doubtful cases the X-rays were of the greatest value in detecting and localizing gas. Though this method of diagnosing gas phlegmon has but recently been employed, Professor Krause of Bonn several years ago showed that subcutaneous emphysema was demonstrable by the X-rays. The first patient to be examined in this connection by Professor Martens was a dentist, who had been wounded below the knee by a fragment of shell. The X-rays showed an extensive layer of gas under the skin, covering the tibia, and bubbles of gas were also demonstrable between the various layers of muscles. The boundaries of the gaseous infection could be clearly seen. In spite of high fever and great swelling of the limb, the patient refused amputation, and insisted on the operation being limited to deep incisions. The further progress of the gas phlegmon was arrested, and the temperature fell; but, as so often happens, Professor Martens says, in such cases, gangrene set in, and the leg had to be amputated at the knee. Professor Martens had found the X-rays useful in revealing the extent and depth to which gaseous infection had spread, and in indicating the best site for incisions and the most suitable level for amputations. In addition to their prognostic, diagnostic, and therapeutic advantages in gas phlegmon the X-rays had, he said, a medicolegal value. A wounded soldier, who had been sent home, brought charges against the medical authorities for having amputated his right arm against his wishes and for insufficient reasons. He stated that he had been only slightly wounded, that he had been given a general anæsthetic and that he had awakened without his arm. He had been operated on by a foreigner, against whom he brought a charge of malpractice, as well as against the senior surgeon in charge of the hospital in which the amputation had been performed. A skiagram which had been taken of the wounded limb clearly showed a fragment of shell and a fracture of the lower end of the humerus, separating the epiphysis from the diaphysis, which was displaced forward. The fracture involved the joint and was probably compound. In front of the fracture a dark shadow was cast by infiltration of the tissues with blood. The skiagram also showed lighter points, which were attributed by Professor Martens and several other X-ray experts to the presence of gas phlegmon. Consequently it was agreed by medical experts that amputation of the limb was the only means of saving the patient's life, more especially as it was proved that gangrene of the skin had already set in.

THE TREATMENT OF THE WOUNDED IN THE FIELD

Professor Körte of Berlin, who has been attached as consulting surgeon to the army in the West and later to the army in the East, has lately published in pamphlet form a lecture on the care of the wounded, which he gave on April 11. Owing to the host of publications by military surgeons at

[1] München. med. Wchnschr., 1915.
[2] Berl. klin. Wchnschr., 1915, July. 19.

the various fronts now appearing, he advises his colleagues always to state the locality where, and the conditions under which, their experiences were gained. Without such particulars, generalizations were apt to be misleading. He had found the organization of the medical service satisfactory, and he warmly recommended the policy of not attempting to make use of every medical officer in the field as a surgeon. In the treatment of wounds, including those inflicted under the dirty conditions of trench warfare, swabbing the skin around the wound with alcohol or tincture of iodine was found to effect satisfactory disinfection. In the case of bullet wounds, infection was usually so slight that immobilization and the early application of dressings were sufficient to ensure the patient's uneventful recovery. On the other hand, wounds inflicted by artillery were always to be regarded as infected. In his opinion, phlegmon, gas phlegmon, and tetanus were due to primary wound infection; secondary wound infections were rare under proper treatment. The modern infantry bullet, provided it did not strike sideways or inflict a wound at point-blank range, was more humane than the old infantry bullet. Like many other surgeons, he had not once seen a definite dum-dum wound.

RESECTION OF THE INTESTINE FOR METASTATIC ABSCESS OF THE MESENTERY.

Ulrichs[1] records the case of a soldier, aged 22, who was wounded on September 24 by a French infantry bullet, which entered his right shoulder. After his discharge, which occurred before the wound of exit, just below the right scapula, had completely healed, he developed osteomyelitis of the left fibula. Accordingly, on December 24, osteotomy was performed, and on January 6 a gluteal abscess on the right side was opened. Towards the end of January occasional attacks of severe abdominal pain were accompanied by acceleration of the pulse and slight fever. There was no vomiting, and aperients were followed by normal evacuations. On February 4 the abdominal wall was rigid and next day there was marked resistance in the right, lower abdomen. Laparotomy was therefore performed, though a definite diagnosis had not been made. A much inflamed coil of small intestine was found, with a thickened, phlegmonous mesentery. Thirty-eight centimeters of the small intestine, which was neither twisted nor kinked, were resected. While the corresponding portion of mesentery was also being resected as near its attachment to the posterior abdominal wall as possible, an abscess in its substance was opened. The abscess was closed, the ends of the intestine were reunited, and the wound in the abdominal wall was sutured. Ulrichs suggested that in this case, in which recovery ultimately took place, the bullet wound of the shoulder must have been infected, and have been responsible for the metastatic, septic thrombophlebitis, the osteomyelitis, and the abscesses of the gluteal region and of the mesentery.

[1] Deutsche med. Wchnschr., 1915, April 8.

GYNECOLOGY

UTERUS

Cuthbertson, W.: The Rôle of Uterine Fibroids in the Production of Sepsis. *Chicago M. Recorder*, 1915, xxxvii, 506.

In calling attention to the rôle which uterine myomata play in the production of septic conditions, the author reports a case which had been diagnosed as septic peritonitis. The patient was an unmarried woman, 25 years of age, who had been confined to bed for three weeks with fever, vomiting, abdominal distention, urinary incontinence, and amenorrhœa for three months. Hæmoglobin was reduced to 25 per cent, red cells to 1,800,000, leucocytes 9 per cent. Operation revealed a submucous cervical fibroid attached very low down in the cervix. The lower part of the cervix covered the top of the tumor like a bell, and this, together with its firm pressure at the vagina, caused it to act as a ball valve, preventing the escape of the menstrual fluid, which being retained and infected caused profound sepsis, simulating septic peritonitis. The tumor showed two large areas of pressure necrosis.

The author makes the point that in the case of an infected fibroid there is no encysting process, such as occurs in acute adnexal infection, as a result of which the toxine is absorbed directly into the patient's system. Another feature is that in uterine fibroids, especially of the submucous variety, the patient's condition is brought to a very low ebb from long continued hæmorrhages. CAREY CULBERTSON.

Stern, S.: X-Ray Treatment of Uterine Fibroids. *Am. J. Obst.*, N. Y., 1915, lxxii, 397.

The author reports that with the Albers-Schonberg technique he treated some 75 cases getting satisfactory results in about 65 per cent of the cases treated. But at the time he finished this series the Freiburg school was reporting 100 per cent cures in the same classes of cases.

So the author went abroad to investigate the methods used in the German clinics. He found that at all of the important clinics they were using *in toto*, or with slight modifications, the Freiburg technique and that their results practically corresponded with those published by Krönig and Gauss. In these clinics he found that operations were performed only in the cases in which X-ray therapy was contra-indicated.

The author reports a series of 21 cases he has treated with the Gauss method. He states that he succeeded in getting a permanent amenorrhœa in every case he has treated, provided the patient was over 40 years of age. In the younger patients it is much harder to get satisfactory results.

He reports 2 cases of unusual interest in that 2 patients he had treated successfully with the older method subsequently became pregnant and went through a normal pregnancy and labor.

In conclusion he emphasizes the following points:

1. The dangers of X-ray therapy in the treatment of uterine fibroids with proper technique are absolutely nil.

2. In cases where the establishment of a permanent amenorrhœa is desired, the massive dose method (Freiburg method) is decidedly superior to the fractional dosage method, as it gives quicker and more satisfactory results.

3. In younger women where the aim is to get a diminution of the size of the fibroid, with a temporary amenorrhœa and a reëstablishment of menstruation, the fractional dosage method is preferable.

4. In these cases, in a comparatively short time after the reëstablishment of menstruation, the patients may conceive, go through a normal labor, and give birth to normal children.

5. All uncomplicated cases of uterine fibroids are amenable to X-ray treatment.

6. The nearer the patients are to the climacteric period, the surer and quicker the results.

7. In cases properly treated, we can look forward to getting practically 100 per cent cures.

C. H. DAVIS.

Pfahler, G. E.: Treatment of Fibroids of the Uterus by the X-Rays. *N. Y. St. J. Med.*, 1915, xv, 334.

Pfahler advises the use of the X-ray in myomata (1) in all cases in older women in whom there is already a well advanced anæmia; (2) in all elderly and young women in whom there is marked organic heart-disease, diabetes mellitus, chronic nephritis, lung disease, and goiter with cardiac symptoms; (3) in all patients beyond the age of 40 in whom there is no contra-indication to the treatment. The older the patient and the nearer she has approached the menopause, the more prompt and satisfactory will be the result.

Its application is contra-indicated (1) in all cases of myomata where the tumor is pedunculated or can be excised without destroying the reproductive powers of the patient; (2) in fibroids that are believed to have undergone malignant degeneration, or that have become gangrenous, or that have become infected; (3) in tumors associated with disease of the adnexa; (4) in those which are producing such marked symptoms that the patient is endangered more by waiting two or three months for

results of röntgen therapy, than by results of an operation.

Modern X-ray treatment is given in series, each series of doses being separated by an interval of three or four weeks. As regards the question of malignancy occurring, the author finds on record no evidence of malignant degeneration in the relics of a myoma or fibroma that has retrogressed under röntgen treatment. He regards the possible danger to other structures or viscera as practically negligible. Menopause symptoms are much less severe than after operation that includes oöphorectomy, and in younger women menstruation subsequently recurs.

The conclusions are as follows:

1. Röntgen therapy must be looked upon as a very efficient adjunct to the gynecologist's armamentarium, and while the rays should be applied by the röntgenologist, he should work hand in hand with the gynecologist.

2. Deep röntgen therapy stops the hæmorrhage associated with uterine fibroids. This is followed by a gradual disappearance of the tumor. This atrophic process may extend over several years and continue long after the cessation of treatment.

3. The treatment of metropathic hæmorrhage is almost uniformly successful.

4. Uterine hæmorrhage occurring at the menopause, when not malignant, will usually respond very quickly. There should be an increase in weight and an improvement in the blood condition following treatment, and when this does not occur suspicion of malignancy should be aroused.

5. Some good results can be obtained in inoperable carcinoma. The deep röntgen therapy should be especially recommended as post-operative treatment in all cases. CAREY CULBERTSON.

Frank, R. T.: The Choice Between Operation and Röntgenization of Uterine Fibroids. *Am. J. Obst.*, N. Y., 1915, lxxii, 408.

The author calls attention to the early enthusiasm of several German observers in the X-ray treatment of uterine fibroids. While in some of the German clinics most of the fibroids are treated with the röntgen rays, the following contra-indications were accepted by Döderlein and Krönig:

1. Pedunculated submucous fibroid partly extruding from the cervix.

2. A combination of fibroid and endometrial carcinoma.

3. Gangrenous and suppurating fibroids.

4. Fibroids in which rapid growth, profuse metrorrhagia and unsuccessful röntgen treatment makes the fear of sarcomatous degeneration likely.

5. Fibroids causing acute incarceration of the bladder. To this they add: "If in addition to the myomata, other complicating diseases are present, it is necessary to decide after due reflection, whether these *per se* necessitate an operative interference, in which case the fibroids, of course, would be removed at the same time."

In several tables of statistics the author tries to show the percentage of cases that could be treated with X-ray and the comparative safety of the two methods of treatment. He finds that the types of cases which give an operative mortality of from 1.5 to 2 per cent are because of complications excluded from the benefit of the rays. In the uncomplicated fibroids the mortality is 0.75 per cent, which compares favorably with Miller's "theoretical" X-ray mortality of 0.63 per cent.

The X-ray treatment of fibroids is both time-consuming and expensive. The cost varies from $100.00 to $500.00 according to the method used. Two or three months' time is required, and if there has been irregular bleeding the treatment must be preceded by curretage and examination of the scrapings. Because of these many requisites the author has found it inadvisable to use the X-ray treatment except in rare instances.

Where necessary or indicated the method is invaluable in the following cases: (1) when operation is absolutely declined; (2) in patients with severe heart-disease or grave nephritis who are bad operative risks; and (3) in a very small group in whom the psychical trauma of operation must be avoided at all costs. C. H. DAVIS.

Novak, E.: The Relation Between the Degree of Menstrual Reaction in the Endometrium and the Clinical Character of Menstruation. *Surg., Gynec. & Obst.*, 1915, xxi, 336.

This study is based upon a review of some 2,000 clinical cases in the gynecological department of the Johns Hopkins Hospital. From these were selected those in which the endometrium had been removed, either by hysterectomy or by curettage. The number of these was 339. In some of these menstruation was irregular, while in others, whatever the character of the pelvic disease, the menstrual rhythm was undisturbed, the periods occurring with absolute regularity. Only the cases of the latter type, numbering 159, were utilized in this study.

The point of departure in all studies on the menstrual histology of the endometrium is the demonstration by Hitschmann and Adler in 1908 that the endometrium undergoes a cyclical developmental change from the end of one menstrual period to the beginning of the next. The high point of these hypertrophic changes is reached just before the onset of menstruation — the premenstrual phase. Marked variations are noted in different cases as regards the degree of this premenstrual hypertrophy. Do these variations bear any relation to the well-known differences existing in women as regards the clinical intensity of the menstrual flow? By comparing only endometriums removed on corresponding days of the menstrual cycle, such a relation is shown to exist. Speaking generally, the more profuse the menstrual flow, the more marked the local hypertrophic changes in the endometrium. The less abundant the flow, the less striking the local reaction in the endometrium. The latter

must, therefore, be looked upon as playing an essentially passive rôle in menstruation.

An important exception to the above generalization is encountered in cases of anteflexion of what is commonly called the congenital type. In this group the hypertrophic changes are, if anything, more marked than those noted in association with other pelvic conditions. This would indicate that the ovary, whose activity appears to govern the degree of hyperæmia and of consequent endometrial hypertrophy, is not functionally deficient in such cases, as has so often been asserted. The scanty menstruation so often noted in cases of this type is perhaps due to a deficiency in a local factor whose activity permits of the passage of blood elements from the vessels toward and into the uterine cavity. Such a theory would seem also to explain the spasmodic dysmenorrhœa so characteristic of congenital anteflexion, for the engorged mucosa, acting as an irritant to the uterine musculature, gives rise to spasmodic and painful contractions of the latter. It is also possible that future work will show that the sterility which is so extremely frequent in such cases is due to a physiological rather than an anatomical deficiency in the uterus.

Watkins, T. J.: Prolapse of Bladder and Uterus. *Tr. Mississippi Valley M. Ass.*, Lexington, 1915, Oct.

The author believes that the pathologic changes in the part of the bladder wall which is attached to the vaginal wall has not received sufficient attention. These changes are due to stretching of this part of the bladder wall and vesical symptoms result. The urethra is usually displaced downward and produces incontinence of urine.

The pathologic changes in the uterus result mostly from circulatory disturbances, i.e., congestion, œdema, varices, and hyperplasia.

The operative treatment alone was considered. The following operations were advised, the choice depending upon the amount of prolapse and the age of the patient, as regards future pregnancies.

1. An advancement operation.
2. Vaginal fixation of the round ligaments.
3. The transposition operation (transposing the relative position of the bladder and uterus). This is also called the interposition operation.

Partial excision or amputation of the cervix is done with all these operations, as may be indicated, and a perineorrhaphy is made.

1. The advancement operation is a very valuable procedure, is well adapted for the cure of many cases, and is easily and safely performed. It consists chiefly in advancing the vaginal wall, including the submucous connective tissue, upon the cervix. The redundant tissue is excised. The peritoneal cavity is not opened. The bladder is freely separated from the anterior vaginal wall and the cervix. "Purse-string sutures" are passed through the vaginal wall, the fascia, the cervix, and out through the connective tissue and mucous membrane on the other side. These sutures are so placed that they restore the urethra to its normal location and close the "ring" of the bladder hernia. This operation gives excellent results in cases of moderate prolapse, and does not interfere with subsequent pregnancies. It should displace all anterior elytrorrhaphies for reasons that must be obvious to all surgeons.

2. Vaginal fixation of the round ligaments into the vaginal wall is done in conjunction with the advancement operation in cases with a greater amount of prolapse, during the child-bearing period, and in cases of retroposition of the uterus.

The chief points in technique, in addition to the advancement operation are:

1. Opening of the peritoneal cavity.
2. The purse-string sutures include generous loops of the round ligaments and may include some of the anterior tissue of the broad ligaments.
3. The transposition operation is the operation of election after the menopause. The fundus of the uterus is attached to the connective tissue and vagina sufficiently low to make recurrence of the bladder hernia impossible. The author has had no recurrence of cystocele after this operation, which he has been doing for seventeen years. The uterus is never an obstruction in the vagina when so placed. Modifications of the operation are given for cases of very large uterus and for cases of complete prolapse with a very small uterus.

The cavities of the uterus and vagina may be completely closed in very extensive cases of prolapse in old women, where there is no objection to occlusion of the vaginal canal.

Robertson, J. F.: Hydatidiform Mole. *N. Y. M. J.*, 1915, cii, 614.

The important points as illustrated by the cases cited are:

1. The comparative youth of the patients and the plurality of multiparæ.
2. The history of having missed only three or four menstrual periods.
3. The enlargement of the uterus.
4. The absence of severe, and sometimes of any, pain.
5. Continuous hæmorrhage and severe anæmia.
6. The inability to palpate placenta or the presenting part through the partially dilated cervix.
7. The absence of a fœtus.
8. No history of having expelled vesicles.
9. The presence in two of the cases of a high leucocytosis.

The dangers are:

1. The retention of a portion of the mass within the uterus.
2. Subsequent development of chorio-epithelioma. Findley collected 250 cases in which he found that 16 per cent of cases developed chorio-epithelioma. The mortality was 10 per cent.

EDWARD L. CORNELL.

Muret: Physiological and Pathological Results of Ventrofixation (Suites physiologiques et pathologiques de l'hystéropexie abdominale directe). *Ann. de gynéc. et d'obst.*, 1915, xli, 545.

Muret emphasizes the importance of repairing the perineum and making a firm pelvic floor when ventrofixation is performed. Otherwise the prolapse will recur, and moreover intra-abdominal pressure may force the intestines down into the pouch of Douglas, forming a posterior vaginal enterocele. He has seen 2 such cases, in both of which the uterus had been fixed to the abdominal wall, but the floor of the pelvis had not been repaired.

Ventrofixation is also sometimes followed by ileus. The author has found 16 such cases in the literature, and discusses the various techniques of ventrofixation used in these cases. He has never had any such mishaps.

In elderly patients he fastens a large area of the fundus high up on the abdominal wall. The cervix is free and moves up and down with the movements of the bladder; the uterus is in constant contact with the underlying tissues, so that there is no possibility of incarceration of the intestine. In young women he makes the fixation much lower down on the uterus and on the abdominal wall. A median ligament is formed which unites the anterior wall of the uterus just below the starting point of the round ligaments to the abdominal wall just above the symphysis pubis. If the ligament lengthens the uterus returns to its normal position; if it does not the position of the uterus is a little higher than normal, but it does not interfere with pregnancy. He has performed 250 ventrofixations and has never had any intestinal complications. A. Goss.

Haines, W. D.: Hysterectomy from the Viewpoint of the General Surgeon. *Lancet-Clin.*, 1915, cxiv, 231.

Regarding hysterectomy from the viewpoint of the general surgeon, Haines calls particular attention to the following facts:

1. Hysterectomy is the operation of choice in chronic infections of the uterus.

2. Total hysterectomy, after the method of Wertheim, is the proper operation for cancer of the uterus.

3. In certain cases of prolapsus uteri, hysterectomy gives the best results.

4. Fibroids of the uterus should be removed either by myomectomy or hysterectomy, when they are diagnosticated.

In conclusion, the author believes that with an improved technique and the proper preparation of the patient, the mortality from hysterectomy should not be greater than 5 per cent.

HARVEY B. MATTHEWS.

Norris, R. C.: Emergency Treatment of Ruptured Uterus and Ruptured Ectopic Pregnancy. *Therap. Gaz.*, 1915, xxxix, 541.

In general the author recommends the tampon treatment for ruptured uterus, and abdominal section for ruptured tubal pregnancy. In the treatment of ruptured uterus various statistics show the operative mortality ranging between 25 and 50 per cent. In a series of 140 cases reported by Kalomenpin, 97 treated without operation showed a mortality of 61 per cent; 33 cases treated by hysterectomy showed 33.6 per cent mortality.

D. L. BORDEN.

EXTERNAL GENITALIA

Holden, G. R.: Relaxed Vaginal Outlet; Its Diagnosis and Treatment. *J. Fla. M. Ass.*, 1915, ii, 65.

The author gives a brief outline of the anatomy of the pelvic muscles and their function, together with the results of any impairment of the pelvic diaphragm. In considering the question of diagnosis he emphasizes especially the pelvic examination with the patient in the standing posture.

No one fixed method is advised for operation, the procedures employed varying with the conditions. Union of the levator ani muscles, however, is considered a requisite for any successful operation.

Non-operative and palliative treatment is considered in some detail. While the author states that, all things being equal, operation is the best treatment for relaxed outlet, he finds many cases that are, for one reason or another, best treated by palliative measures.

Such cases are: (1) patients in whom the condition is slight and who may be expected to be cured by palliative treatment; (2) patients who are not first-class operative risks on account of age or some physical impairment; (3) women who absolutely cannot afford the necessary expense and loss of time.

The introduction of some form of suitable pessary is the palliative means usually employed. Before the introduction of a pessary all local inflammation or irritation must be cured. The tubes and ovaries must be normal and the uterus non-adherent. Abnormal positions of the uterus must, as a rule, be corrected.

The pessary must relieve the symptoms caused by loss of support. It must not, however, be so large that it causes discomfort or pain by its presence. The patient is not in any way conscious of a properly fitting pessary.

The proper selection and fitting of a pessary requires considerable care and skill. It requires careful measurements of the length and breadth of the vaginal canal.

The dangers of pessary treatment can be avoided by care on the part of the patient and strict supervision on the part of the physician.

Bernstein, H. A.: An Improved Method for the Repair of the Lacerated Perineum. *N. Y. M. J.*, 1915, cii, 650.

The rejoining of the separated parts of the perineal muscles or the substitution of muscular bands from nearby structures to take the place of those

destroyed is the operation of choice today, and marks the greatest advance in corrective surgery of this part of the female organism since the first perineum was sutured almost one thousand years ago. The author does not favor the old operation in which flaps of vaginal mucosa are raised, as this procedure disturbs the circulation; œdema and sloughing are encouraged; infection invited; and healing delayed.

The steps in the author's operation are as follows:

1. With tenacula or sutures catch up the tissues at the entrance of the vagina just below the lowest caruncle on each side; make an incision between these two points, and after slightly separating the mucosa from the fascia make the incision into the fascia and raise it slightly from its bed.

2. With blunt scissors or the finger make an incision into the connective tissue on each side leaving the center intact, and expose the levator ani muscles.

3. Catch up the strands of the levator muscles on each side and bring them together in front of the central ridge with three or four chromic catgut sutures.

4. Close the triangles thus created by bringing the original guiding sutures together. Suture first the vaginal side of the wound from within out. There now remains merely a straight line of fascia and skin extending from the vagina to the bottom of the tear.

C. D. HOLMES.

Bonnot, E.: A New Technique for Perineal and Rectocele Operation. *Med. Rev. Revs.*, 1915, xxi, 549.

Bonnot describes, with figures, a modified Montgomery perineorrhaphy. With the posterior vaginal wall on the stretch, for which the author uses Bonnot's or Gelpi's vaginal retractors, a horizontal incision is made along the mucocutaneous line of the vagina, close to the mucous membrane of the vagina. The mucous membrane of the posterior wall of the vagina is separated from the underlying structures for a sufficient distance. A long-bladed hæmostat forceps is applied in a triangular fashion to this denuded flap and the mucous membrane between the forceps blades is cut away. This leaves the anterior wall of the levator ani muscles and rectum well exposed. The forceps are then released and all bleeding points secured. The levators are brought together with twenty-day chromic gut. If the rectocele is large, the muscles may be rolled together by two or three lines of sutures, placed one upon another. The mucous membrane is approximated by interrupted silkworm gut sutures which include the muscle beneath. The skin is closed vertically with interrupted silkworm gut.

The advantages claimed for this operation are:

1. Open field of operation and, hence, complete control of hæmorrhage can be secured.

2. Good approximation of the levator ani muscles.

3. Nice approximation of the skin and mucous membrane, preventing hæmorrhage.

HARVEY B. MATTHEWS.

MISCELLANEOUS

Prochownick, L.: Gynecology and the Pancreas (Gynäkologie und Pankreas). *Monatschr. f. Geburtsh. u. Gynäk.*, 1915, xlii, 241.

The author describes in detail a case of necrosis of the pancreas on which he operated, and from this case and a review of the literature he concludes that the pancreatic juice, which is not toxic in itself, may become activated by certain processes and substances so that it becomes an active proteolytic toxin. This activation may be brought about by trauma or by necrosis of the cells of the pancreas. In either case there is a rapid intoxication of the whole body, characterized by serous-hæmorrhagic exudate, hyperæmia of the peritoneum, and fat necrosis. Necrosis of the pancreas may be caused by bacterial infection or by thrombosis and embolism.

After discussing the symptoms of necrosis of the pancreas, the author discusses the relation between this condition and certain gynecological affections; there being no doubt, he believes, that such a relation exists. In diabetes during pregnancy and in severe cases of pernicious vomiting there is an interaction between the pancreas and the sexual glands. Surgeons frequently report cases of women with chronic diseases of the gall-bladder and ducts who have attacks only during pregnancy, labor, and the puerperium. One case is recorded in which necrosis of the pancreas followed the puerperium, and in several cases the surgeons have mentioned the fact that the woman had borne a child not long before.

Necrosis of the pancreas may be caused by acute and chronic gynecological affections that involve adhesions of the omentum or thrombosis in the veins of the omentum or mesentery. This is particularly liable to follow gynecological operations. There is no absolute proof of these assumptions of the author, but they should at least stimulate further observation along the same lines.

A. GOSS.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Bland, P. B.: Bilateral Tubal Pregnancy. *Report Jefferson M. Coll. & Hosp.*, 1915, vi, 104.

The author reviews the literature and gives brief protocols of the 42 cases already reported.

While the majority of cases of this nature are of comparatively recent record, it is interesting to note that according to Jayle and Nandrot of the Gynecological Clinic of the Hospital Broca, Paris, a case of this character was first described by Jacques Noier, as early as 1595. The second was reported by Gabriel King in 1747, the third in chronological order by Moreau in 1853, and the fourth by von Ott in 1885. Some of the more recent reports must be accepted with a degree of incredulity, because many of them were not confirmed by microscopic investigation. However, the clinical picture in each was typical of tubal hæmatoma.

The author's own case is that of a woman 33 years of age. She was married at 26 and had since then gone through two pregnancies, the labors being instrumental at term. Her menstrual history was normal except for considerable pain during the flow. Her last normal period occurred December 23, 1911. On January 21, 1912, she stained a napkin, but on January 25, flowed for two days, normal in amount. On January 29 she was seized with violent tearing pain in the lower abdomen, became cold, pale, and faint. This attack lasted thirty minutes and six hours later another occurred. For two weeks subsequently she was more or less confined to bed. On February 12 and 13 she suffered from two further attacks of violent abdominal pain and on February 19 began to flow scantily. Operation was performed on March 7, 1912. The lower abdominal cavity was found to be filled with clotted blood, with intestinal and omental adhesions, and a large irregular mass was occupying the site of the right ovary and tube. The left tube and ovary were bound down by adhesions, and when freed a small dark nodular mass was disclosed in the inner ampullar portion of the tube. The uterus with both appendages was removed. Both tubal masses proved to be hæmatomata. In both, segments of chorionic villi were disclosed by microscopic section. On the left side the pregnancy seemed to be interstitial in location.

CAREY CULBERTSON.

Copeland, G. G.: The Treatment of Eclampsia; Methods Used at the Toronto Western Hospital Obstetrical Department. *Canad. J. M. & S.*, 1915, xxxviii, 79.

Although a subject frequently written about, this contribution is of extreme interest. The author briefly reviews the salient points about this disease, and the actual technique of treatment.

Eclampsia occurs in about 1 per cent of women entering lying-in hospitals, but is subject to wide variations. Most cases are in primiparæ, 80 per cent. Taking the country as a whole, the maternal mortality is about 25 per cent and the fœtal mortality is more than 50 per cent. Regarding the etiology, the author believes that there is a specific eclampsia poison or group of poisons, probably of protein composition. There are two types of this disease: (1) the liver type, in which the patient is jaundiced, vomits, has a tendency to hæmorrhages; changes in the urine are not marked; albumin is small in quantity; the blood-pressure is not high; convulsions are not marked; coma is common; there is little if any œdema; and the pulse is poor. These cases do badly. The other type is the kidney type which is characterized by a high tension pulse, severe headache, and epigastric pain; nervous symptoms are marked; œdema is generally present; the urine is scanty, of high specific gravity, and contains a large quantity of albumin, blood-casts, granular and hyaline casts, and frequently free blood. On boiling, this urine frequently becomes solid. The total nitrogen excreted is markedly diminished. These cases usually have severe convulsions.

The actual technique of treatment as conducted at the Toronto Western Hospital is as follows:

1. Give one-half a grain of morphine sulphate, hypodermically, and repeat, using one-quarter grain as soon as necessary, but do not give chloroform.

2. Prevent the patient from injuring herself; have a sheet tied over her, so she cannot spring out of bed. In a fit, place a rolled handkerchief between the teeth to prevent the tongue being bitten, and turn the patient on her side to prevent the aspiration of vomitus, infected secretions, etc., that might easily give rise to an aspiration pneumonia.

3. Give 1,000 ccm. of normal saline at 100° F. under the breasts, not into them.

4. Withdraw a quantity of blood by aspiration of a vein, under antiseptic and aseptic precautions. This directly lowers the blood-pressure and removes a definite amount of the eclamptic toxin which is causing the convulsions and the high blood-pressure. The amount of blood to be withdrawn is a matter of judgment. A big, plethoric woman who is cyanosed can stand the withdrawal of 20 to 30 ounces easily, with the greatest benefit; the volume of the blood is replaced by the saline. In an anæmic, emaciated woman, with low blood-pressure, the abstraction of 5 or 10 ounces of blood does good.

5. Empty the uterus. Carefully examine vaginally to ascertain the condition of the cervix. If it is soft and will admit three fingers, get the woman prepared for instrumental delivery. Give a general anæsthetic. Nitrous oxide and oxygen are the best, then comes ether. In case the cervix is rigid and small, use a good type of hydrostatic bags. This is the safest and surest means of dilating the cervix without trauma or shock, and it imitates Nature's bag of waters.

6. Eliminations: (1) By the intestinal tract. Give several enemas. When the bowel is unloaded, give a large enema of magnesium sulphate, two ounces dissolved in a small quantity of water. Having cleared the bowel, start giving tap water, about 110° F. Saline is not necessary. If possible, wash out the stomach and introduce two ounces of magnesium sulphate. (2) By the kidneys and skin. Hot packs and stupes are of the greatest service in overcoming the spasm of the superficial blood-vessels and thus lowering blood-pressure. They calm the nervous system and help in an indirect way to induce diuresis by relieving the spasm of the renal vessels.

7. An ice cap applied to the head calms the nervous system appreciably.

8. In cases of great depression, where the circulatory system needs stimulation, aromatic spirits of ammonia and atropine are good. A. H. SCHMITT.

Leavitt, F.: A Few Remarks on Cæsarean Section. *St. Paul M. J.*, 1915, xvii, 601.

After reporting a series of his own cases, showing the different indications for cæsarean section, the author states that the prognosis of section when performed by experienced surgeons and under favorable circumstances is, as far as the child is concerned, better than in the use of medium and high forceps, prophylactic version, or the induction of premature labor. It is even better than in breech, face, and brow presentations, persistent occipito-posterior positions, and prolonged expectancy.

Some of the advantages which he claims cæsarean section has over what is termed natural or normal birth are: (1) it eliminates labor, which is quite as much to be dreaded as the operation; (2) it prevents trauma of the cervix, pelvic floor, and perineum. The child, too, escapes injury, and the delivery can be arranged under advantageous circumstances.

A. H. SCHMITT.

Brown, W. M.: A Modification of the Technique of Abdominal Cæsarean Section. *Am. J. Obst.*, N. Y., 1915, lxxii, 415.

The author points in a general way to the development of the various modifications in the technique of performing cæsarean section, and quotes statistics showing the lowering in the mortality attending this operation. In a series of 40 cases under the author's care the death-rate was 10 per cent, and it included both primary and late operation on cases that had eclampsia, toxæmia, placenta prævia, tuberculosis, and heart-disease, as well as contracted pelves. Many of the patients had more than one indication.

Believing that the greatest danger in the usual cæsarean section is trauma of the peritoneum, especially trauma to the intestines and mesentery, with its resultant shock to the sympathetic nervous system, the author has made a modification of the Davis operation which he thinks will be of distinct value in most cases.

The high incision is made in the usual manner, about 10 cm. long, and entirely above the umbilicus, if possible. By pressure on the sides of the abdomen an assistant holds the uterus firmly up against the abdominal incision while the cut in the uterus is being made. When the uterus has been carefully opened, and before the child is delivered, the uterine cut is sewed to the abdominal wound with eight or ten interrupted sutures or possibly by a continuous suture. The operation is completed in the usual manner, these extra sutures being removed just before the closing layer is placed in the uterine wall.

The author thinks that this procedure lessens the trauma to the peritoneum and believes that it will be of distinct benefit. C. H. DAVIS.

Benthin, W.: Criminal Abortion (Über kriminelle Fruchtabtreibung). *Ztschr. f. Geburtsh. u. Gynäk.*, 1915, lxxvii, 572.

The author reviews the literature on the subject and gives statistics in regard to the frequency, the morbidity, and mortality of criminal abortion. From these statistics it is evident that even in East Prussia, where the population is largely rural, abortion is on the increase, though of course not to so great an extent as in the large cities.

Abortion is performed in all classes of society, and on married, more frequently than on single, women. While unmarried girls have abortion performed for the sake of escaping shame, the married ones resort to it for various social or economic reasons, on account of poverty, because they have too many children already, etc. In at least a fourth of the cases it is due to a desire to avoid the responsibility of having children. While it will doubtless be impossible to ever overcome the practice entirely, vigorous efforts should be made to suppress it. Some of the means suggested are strictly enforced laws against the sale of intra-uterine douches and pessaries. Even if these did not materially reduce abortion they would certainly reduce the morbidity and mortality from it. Another important thing is to insist on higher requirements for midwives. They should be trained and stringent regulations passed for preventing untrained women from practicing. Private obstetrical hospitals should be subjected to the most rigorous examination and control. There should be a law compelling the reporting of every case of febrile abortion. Other preventive measures will have to be of a sociological nature.

A. Goss.

Windell, J. T.: Pyonephritis Gravidarum. *Louisville Month. J.*, 1915, xxii, 105.

The author carefully reviews the subject of pyonephritis gravidarum, not from his own experience but from the statistics of others.

In short nearly all observers agree that the bacteria can reach the renal pelvis by three routes; viz., (1) through the ureters, (2) through the bloodstream, and (3) through the lymphatic channels.

The organism most frequently responsible is the bacillus coli communis (80 per cent). The right kidney is more commonly implicated than the left. The diagnosis of pyonephritis gravidarum entails no special difficulty.

The main points in the treatment are: (1) absolute rest in bed; (2) fluid (preferably milk) diet; (3) mild catharsis; (4) hexamethylenamine (0.5 gm.) given every three hours night and day in a full glass of cold water, lessening the dose as the patient improves; (5) posture to relieve the ureter on the affected side, if the infection is single; (6) autogenous vaccine treatment.

The interruption of pregnancy is seldom, if ever, necessary with the above treatment.

A. H. Schmitt.

LABOR AND ITS COMPLICATIONS

Hornstein, M.: Contracted Pelvis and Difficult Labor. *Am. J. Obst., N. Y.*, 1915, lxxii, 421.

The author gives the following summary of his paper: 1. Of 2,000 consecutive cases, only 42 had external conjugates of less than 17 cm.; of these 42 only 7 had true conjugates less than 9 cm. They all had spontaneous labors except 4, and these had complicated presentations.

2. The children born of these women were of moderate size corresponding to the slender build of the mothers.

3. Of the 2,000 cases 97 required operative assistance, but only had pelves which can be classed as contracted and the causes of dystocia were various, such as occiput posterior, transverse, weak pains, prolapsed arms, brow, etc. The presence of contracted pelves in some of these was only a coincidence.

The conclusions are: 1. Small external measurements when they are all proportional with an external conjugate of 15 cm. or over, provided they are found in women whose slender build accounts for a small pelvis, deserve a fair test of labor. They usually have small children and will deliver spontaneously if the fœtus presents favorably.

2. A fair test of labor in a doubtful case and especially in a primipara must include a period of four to six hours in active labor with the membranes ruptured, although, as a rule, three hours will decide the outcome.

3. Cæsarean section for relative contraction in a primipara means repeated cæsarean for subsequent children; whereas extraction of the child through Nature's passages, even if it should result in a stillbirth will enable the woman to deliver her subsequent children *per viam naturalem* since a good deal of resistance, which is encountered in primiparæ, is due to the soft parts. C. H. Davis.

Carter, P. J.: Method to Lessen Perineal and Vaginal Tears During Childbirth. *N. Orl. M. & S. J.*, 1915, lxviii, 169.

For the employment of this method of delivery it is necessary that the patient be delivered on a table or some hard flat surface so that the rectum is plainly visible and the tip of the coccyx can be plainly felt. When the occiput is seen distending the vulva, the palmar surface of the left hand is placed over the head, while the fingers of the right hand are introduced below the rectum and just in front of the coccyx. The fingers of the right hand make a downward, inward, and upward excursion while the palmar surface of the left hand moves upward, both maneuvers aiding extension of the head and supporting the perineum. This is continued until the chin is caught by the right hand. Now when you wish to deliver the head simply push up the chin with the right hand and guide the occiput with the left, which imitates the third maneuver in the mechanism of labor. Once the head is delivered, grasp it with the palms and pull it in a downward direction until the anterior shoulder is under the symphisis, as far as the middle of the humerus. Then with the left hand and wrist support the head while the right hand supports the perineum as in delivering the head. The author advocates the use of a few drops of chloroform after the head is controlled at the vaginal outlet.

C. D. Holmes.

Stoddard, J. M.: Complete Intraplacental Uterine Rupture During Labor. *J. Indiana St. M. Ass.*, 1915, viii, 421.

The author reports the case of a patient, aged 23, who had had general good health prior to marriage, but had had six abortions since that time, the pregnancies ranging from two to three months. She was again pregnant at term. On examination the os was found not dilated, the cervix projecting, a head presentation, the fœtus alive. The pains were mild and ineffectual; the membranes had ruptured the night before. On gentle manipulation of the fœtus pains began and recurred at regular intervals. Shortly, the character of the pains suddenly altered and general abdominal discomfort supervened. The pulse was 145 to 150, the countenance pallid, the extremities cold and numb, respiration sighing, and the patient had a sense of impending death. Dilatation now was the size of a quarter; no blood was escaping from the os, but the abdomen was distended with fluid. A diagnosis of internal hæmorrhage was made, and a cæsarean section was done. On opening the abdomen large amounts of free and clotted blood escaped. The fœtus was pale and limp, and could not be resuscitated. A lineal tear three inches long was found

in the uterus through the attached placenta, but no part of the fœtus projected through the tear. The lining of the uterus was degenerative and of a dirty yellow color. The uterus was removed entire. The patient being moribund at the time of operation expired on the table. C. D. HOLMES.

Rothschild, C. J.: Episiotomy, a Perineal Safety Measure. *J. Indiana St. M. Ass.*, 1915, viii, 416.

The author discusses the indications for this operation, gives the technique for the same, and a table showing its use in the practice of some prominent obstetricians.

The indications for episiotomy are vulva infantalis, with fully developed internal genitals; extremely large ligamentum triangularis; former perineorrhaphy; narrowing of the introitus due to pathologic conditions, such as œdema, hæmatoma of the vulva, abscess of Bartholin's gland, neoplasms, extremely large condylomata accuminata, extremely high degree of vaginismus; rigidity of perinuem; brittle-like perineum (in old primiparæ); extremely large fœtal head, or pathologic presentations — forehead, parietal, face; forceps delivery; a strong indication for episiotomy is the condition in which the head, in the presence of good pains, does not come down into the vulva, but the occiput seems to be going forward — the posterior part of the perineum bulging, while the anterior part remains flat.

When the head has stretched the levator muscles; when the anus opens up and comes forward; when the perineum is seen to be resistant and about to tear; then is the time to do an episiotomy.

The blunt-ended blade of a pair of scissors is placed on the mucosa of the vagina and the other blade outside on the skin between the anus and the tuber ischii, and with the cutting angle at the median raphe, the sphincter is pushed downward and the blades quickly closed. C. D. HOLMES.

Rongy, A. J.: Twilight Sleep. *N. Y. St. J. Med.*, 1915, xv, 340.

The author makes the point that this method of treatment must be judged from the standpoint of analgesia and not of amnesia, ignoring the testimony of the patients as incompetent. His report is based on experience in a series of 300 consecutive cases in the obstetrical services of the Jewish Maternity and Lebanon Hospitals.

As regards results, these cases are divided into three groups, as follows: (1) 231 cases, 77 per cent, in which there was complete amnesia with varying degrees of analgesia; (2) 37 cases, 12 per cent, in which there were varying degrees of analgesia without amnesia; (3) 32 cases, 11 per cent, in which the treatment failed to produce the desired effects. The author formulates his conclusions as follows:

1. Standard solutions are absolutely essential for the success of the treatment.

2. No routine method of treatment should be adopted. Each patient should be individualized and the mental state made the guiding point for the injections of scopolamine. A subconscious state must be evenly maintained.

3. Facilities should be such that the patient is not unduly disturbed.

4. A nurse or physician must be in constant attendance.

5. This method of treatment is best carried out in hospitals but can be utilized in the home, especially if not begun until the end of the first stage of labor.

6. It does not affect the first stage of labor but the second stage is prolonged.

7. Pain is markedly diminished in a great per cent of cases, while amnesia is present in 75 per cent of patients, but labor is not painless, as is generally supposed.

8. This treatment does not in any way interfere with any other therapeutic measure which may be deemed necessary for the termination of labor.

9. Fœtal heart sounds must be carefully watched. Sudden slowing calls for immediate delivery, if possible, or treatment must be discontinued. Fifteen per cent of the babies were born oligopnœic.

10. Asepsis and antisepsis cannot be rigidly enforced.

11. No change in the course of the puerperium was observed, and convalescence progressed very smoothly in the entire series.

12. Women of a higher grade of intelligence are best suited to this form of treatment.

13. It is best carried out in primiparæ or in multiparæ with tedious labors. It has no place in short labors.

14. It is an ideal form of treatment in patients suffering from cardiac disease.

15. If the physician, as well as the patient, will be satisfied with amnesia as the object to be accomplished, then only will the scopolamine-morphine treatment be established in its proper place in obstetrics. CAREY CULBERTSON.

Polak, J. O.: Morphine and Scopolamine Amnesia in Obstetrics. *J. Am. M. Ass.*, 1915, lxv, 994.

Beach and the author have studied over 400 labors conducted under scopolamine-morphine amnesia. In this series there has been no maternal mortality and less than the usual morbidity. No child has been born dead. There has been no case of post-partum hæmorrhage following any of these deliveries. A moderate degree of oligopnœa was present in 15 per cent of the cases. Real asphyxia was noted less frequently than after ordinary labor. Three children died within the first ten days after delivery. All three were necropsied and the following were the pathologic diagnosis: diaphragmatic hernia with transposition of the viscera; hæmorrhage into both suprarenal capsules; and microcephalus. The lungs were specially examined for atalectasis, with negative findings. The condition of the baby at birth and the spontaneity of its first cry are determined by the skill of the operator in producing the "twilight state" with the minimum dosage and the length of time of the second stage.

The following conclusions are reached:

1. The twilight sleep state is a reality and is applicable in any labor in which there is no primary inertia, marked pelvic contraction, or the presence of obstetric accidents.

2. It is especially applicable to nervous women of the physically unfit type.

3. It is a valuable adjunct in the management of borderline contractions for it allows the woman a full test of labor.

4. It is distinctly a first-stage procedure and bears the same relation to the first stage as chloroform and nitrous oxide bear to the second stage: it relieves the pain, but does not inhibit the progress of labor.

5. It is particularly useful in cardiac cases as it relieves the nervous apprehension and secures dilatation with less muscular effort.

6. It diminishes the shock of labor, whether that labor be normal, prolonged, or operative.

7. It does not diminish the milk supply.

8. It does not predispose to post-partum hæmorrhage.

9. It does decrease the number of high forceps operations.

10. Finally, it has a distinct place in hospital obstetrics and should be tried out by those who have control of sufficient material definitely to determine its position in obstetric practice. EDWARD L. CORNELL.

Smith, E. W.: Preliminary Report on One-Hundred Cases Treated by the Scopolamine and Morphine Method of Gauss. *N. Eng. M. Gaz.*, 1915, l, 476.

In 100 cases of twilight sleep conducted by the author, of which 68 were primiparæ and 32 multiparæ, 93 per cent were successful, analgesia and amnesia being induced in 93 of the cases. Of the 7 failures, 5 were under dosed, being too far advanced in labor to receive thorough treatment; 2 cases had complete amnesia for hours, but owing to a rush hour in the delivery room, received their last dose at too long an interval and had islands of memory.

As a result of the above cases the author has arrived at the following conclusions:

1. Large dark-complexioned women seemed to require larger doses, and small light-haired or red-haired women were most easily influenced.

2. About 4 per cent had some delirium; most of the cases requiring restraint suffered from distended bladder and seemed to feel discomfort, without realizing the exact nature of the trouble.

3. No hæmorrhages were noticed and the percentage of cases delivered artifically was larger than the usual hospital average.

4. The secretion of milk is better, on account of the absence of fatigue, and the convalescence of the mother is usually better and involution more rapid for the same reason.

5. While the expulsive stage is somewhat lengthened, labor as a rule is shortened.

6. The secretion of urine is rapid and the bladder needs watching.

7. The drug must be pure and in standard solution.

8. Careful observations must be made of pulse, respiration, and fætal heart sounds.

9. A prolonged second stage should be avoided. Two hours perineal stage in primiparæ, and one hour in multiparæ, should be the rule, with earlier interference if indicated.

10. The maternal and fœtal mortality was negative. W. D. PHILLIPS.

Davis, C. H.: Nitrous-Oxide Analgesia in Obstetrics; Its Advantages Over the Freiburg Method. *J. Am. M. Ass.*, 1915, lxv, 992.

It is the custom at the Presbyterian Hospital to begin the administration of the analgesia whenever the uterine contractions become painful. If started early in labor, a higher percentage of oxygen is used and three or four inhalations given. Later less oxygen is used and five or six deep inhalations allowed previous to the bearing-down effort. The gas must be inhaled with the first suggestion of a contraction; after the patient has made strong traction on the straps, which are fastened to the foot of the bed, she is often given another inhalation containing a larger percentage of oxygen. In giving the analgesia the gas-bags should be only about half filled. The mixture required varies considerably and must be determined for each patient.

For the nitrous-oxide-air analgesia, the hospital has a machine with an automatic regulator and a foot control. This apparatus has an advantage over that used by Guedel in that a constant pressure in the gas-bag can be maintained and the administration throughout labor may be controlled without assistance. In the maternity ward of the Presbyterian Hospital a mixing apparatus is used equipped with automatic regulators, by which a constant pressure in the gas-bag can be maintained. The use of this apparatus lessens the amount of nitrous oxide and oxygen used. For use in the home there is a similar machine, but on a smaller scale, so that it may be carried easily in an automobile. The mixture of the gases is accomplished with a single dial so that the nurse or intern, if at the hospital, or some member of the family, if in the home, may readily give the proper mixture. Since the patient should make traction during her pains, self-administration is not practical during the latter part of labor, although it may be used in the early part.

By using nitrous oxide and air, analgesia has been maintained for three and one-half hours with a 100-gallon tank of gas. After considerable experimenting, the hospital made a charge of $1.50 per hour for the nitrous oxide and oxygen used in maintaining analgesia. As large cylinders are used, allowance for leakage is allowed and usually gives the hospital a small profit.

In no case has it been necessary to maintain the analgesia for longer than six hours. In multiparæ

it is rarely necessary to give it for more than two hours. In primiparæ the labor is usually terminated in less than three hours from the beginning of the painful contractions. Should an operative delivery be necessary, the analgesia is increased to anæsthesia. Much depends on the prenatal care of the mother and the position of the child. In maintaining analgesia the confidence of the patient is necessary and mental suggestion is of great value.

In no case will the analgesia lengthen labor; rather it will shorten it because of better assistance on the part of the mother. Of course it is easier to carry a hypodermic needle than a gas machine, but the "Freiburg method" should be used only by the specialist while nitrous oxide and oxygen analgesia may be employed safely and efficiently by any physician. It is as safe in the home as in the hospital. It may be used in all classes of cases, the results varying with the coöperation of the patient and the skill of the obstetrician. It gives an increased control over the patient in that there are none of the hysterical outbursts so often seen in the delivery room. EDWARD L. CORNELL.

Craig, L.: Nitrous-Oxide Oxygen Analgesia in Obstetrics. *Chicago M. Recorder*, 1915, xxxvii, 514.

The use of nitrous oxide oxygen analgesia in obstetrics is proving to be very satisfactory, and upon observing and administering the analgesia in a number of cases, the author has found that the ratio of the gases and the amount required to produce analgesia varies with different subjects. She describes her technique as follows, the new apparatus originated by Dr. Will Walter being employed:

As the end of the first stage of labor approaches the gases are turned on, using about one-tenth of oxygen to about nine-tenths of nitrous oxide. The breathing bag is filled with this mixture and just before the uterine contraction the nose-piece or face-mask is applied and the patient is directed to breathe deeply and rapidly, keeping the lips firmly closed (if the nose piece only is used) so that none of the gases escape through the mouth. Usually six or eight breaths are sufficient to produce analgesia, and the patient is able to work with her pains and yet be unconscious of painful sensations.

Among the various cases observed the greatest length of time analgesia was employed, was 24 hours. The amount of nitrous oxide consumed in this case was, according to the author, unusually low, which was probably due to the efficiency of the apparatus. The average length of the second stage of labor in 1,500 cases was one hour and 37 minutes; ordinarily the administration of the analgesia is not begun until the end of the first or the beginning of the second stage. Just before expulsion, the face-mask is applied and a deeper anæsthesia is brought about by the use of 2 per cent oxygen and 98 per cent nitrous oxide. At this time ether or chloroform vapor may also be added in a small cup at the side of the mask, for this purpose, and the vapor inhaled with the gas oxygen without removal of the mask.

W. D. PHILLIPS.

PUERPERIUM AND ITS COMPLICATIONS

Lindsay, A. H.: The Crime of Puerperal Sepsis. *Texas M. News*, 1915, xxv, 10.

Every case of puerperal infection is a crime, while rigors and temperature are prima facie evidence of guilt, and judgment should be rendered without further introduction of testimony or even an argument unless the defendant can show beyond the question of a doubt that his victim was possessed of a pyosalpinx.

The fear of death or invalidism from childbearing is next to, if not the greatest, factor today in the question of race suicide. If the hypothesis is correct that women should not die as a result of childbearing, then it behooves scientific investigators and guardians of human life to ask "why?"

A novice in surgery who kills a worthless man through an error in technique either gets frightened so badly that he quits surgery or goes to some hospital and learns how to be a good surgeon. But if he kills a good mother from ignorance, carelessness, or indifference, instead of quitting or learning how, he goes the next day or night and kills another.

Why should the filthy hair be removed from the vulva and pubis and the mons veneris and labia be sterilized in a median line laparotomy and be left untouched in a confinement case either with or without a lacerated perineum?

The trouble lies in the barbarous and ignorant tradition handed down to us from the past ages. With all our scientific discoveries, we have not even yet been able to throw off the effects of the past thousands of years of habit. The average mother of today well understands the importance of absolute cleanliness in a surgical operation, but it is difficult to make her realize its importance in a confinement case. EDWARD L. CORNELL.

GENITO-URINARY SURGERY

KIDNEY AND URETER

Plotkin, T.: Results in Eighty Cases of Pyelography (Les résultats de 80 pyélographies). *J. d'urol.*, 1915, vi, 431.

Plotkin gives the details of 11 of his cases and 14 pyelograms, showing the conditions found. He describes the technique used in his service at Joseph's clinic.

If catheterization causes pain or hæmorrhage pyelography should never be performed. A small catheter should always be used, so as to permit reflux of any excess fluid and thus avoid overdistention. Many of the accidents reported have been due to overdistention. There were complications in only 3 of his cases. One patient had colic severe enough to confine him to bed for twenty-four hours; a second case had slight colic; and a third had fever and an excited mental state for four hours.

Ten per cent collargol is used, and is injected very slowly from a simple syringe containing 20 ccm. The patient is told to make it known as soon as he feels the slightest pain and the injection is then stopped. The amount injected varies from 2 to 30 ccm. More than 30 ccm. is never injected, even when there are large cavities due to hydronephrosis. The bladder is washed out afterwards with physiological salt solution.

Plotkin believes that pyelography is very valuable in the diagnosis of floating kidney and of the early stages of hydronephrosis. It is also valuable in pyelonephritis where stagnation of the pus has produced cavities, in cases of renal calculus, and of anomalies of the kidney, especially when there is a tumor of the kidney. In the hands of an expert the procedure is absolutely without danger, as it is nothing more than a simple rinsing out of the pelvis. A. Goss.

BLADDER, URETHRA, AND PENIS

Crissey, R. H.: Clinical Thermometer in the Bladder. *J. Mich. St. M. Soc.*, 1915, xiv, 473.

A very interesting and somewhat unusual case is reported by Crissey in which a clinical thermometer was lost while taking a vaginal temperature.

A young woman, 25 years old, while taking her temperature, placed the instrument *in situ* rather blindly and when she came to remove it, the instrument could not be found. It was at once reported, and the physician, thinking that it had slipped into the vagina beyond the patient's reach, made a vaginal examination but could find no trace of it. However, in rotating his finger anteriorly, he accidently felt the instrument through the anterior vaginal wall.

She was at once taken to the hospital, where, upon cystoscopy, the thermometer was located in a transverse position, the ends being covered with the mucous membrane of the bladder. The patient was then placed in the knee-chest position and a Kelly direct vision cystoscope was passed into the bladder, but on account of the highly irritable condition of the bladder, causing violent contractions, further manipulations were abandoned.

The patient was put to bed; hyosin and morphia given, and after a few hours the Kelly cystoscope with a pair of alligator forceps was introduced into the bladder, the instrument was seized and turned to the sagittal position. The cystoscope was then carefully slid down over the top of the thermometer until the end was reached, and accidently the end of the instrument became engaged in the cystoscope which was immediately shoved down into the bladder over it. By means of the alligator forceps the thermometer was then easily recovered.

Crissey's reason for reporting his case is to warn against the indiscriminate taking of vaginal temperature, and more especially in allowing patients to take this temperature themselves. He believes that the taking of vaginal temperature is in all but rare cases uncalled for, as rectal temperature is just as reliable. H. W. E. Walther.

GENITAL ORGANS

Hinman, F.: The Operative Treatment of Tumors of the Testicle; Report of Thirty Cases Treated by Orchidectomy. *Pacific M. J.*, 1915, lviii, 656.

The author's conclusions are as follows:

1. Orchidectomy will cure from 15 to 20 per cent of teratoma testes. Obviously a cure is possible only when the testicle is removed before the onset of glandular or other metastases.

2. A cure cannot be assured until nine years after operation, although the danger of recurrence after four years is very small (only three cases reported) and progressively diminishes.

3. Cancer of the testicle metastasizes in practically every case first and primarily to a limited zone of lumbar lymph-nodes which lie on the aorta for the left testicle and on the vena cava for the right.

4. Involvement of these primary lymph-nodes may occur early or late.

5. The experience of various surgeons in a total of 46 cases has demonstrated in suitable cases the feasibility and technical ease of the radical operation with a combined surgical mortality in all cases of only 11 per cent.

6. Radical operation should never be undertaken when lumbar metastases are recognizable clinically.

7. Sufficient time has not elapsed and the cases are so scattered that it has not been possible to get the ultimate result in all of the patients treated radically. Forty-six per cent are alive, 1 for five years; 1 for four years; 5 for almost three years; 2 for over two years; and 11 for one year or less. There is a probable cure in at least 4 cases which had lumbar glands invaded with cancer at the time of the operation. Simple castration could not have benefited any of these cases, and their cure is directly attributable to the early and clean removal of the affected lymph area. I. S. KOLL.

Merritt, E. P.: Epididymotomy; a New Operation. *J. Am. M. Ass.*, 1915, lxv, 949.

The author describes epididymotomy as he practiced it in 75 cases of gonorrhœal epididymitis with prompt relief of pain and discomfort.

The site is prepared as for any surgical operation on the scrotum. Three per cent iodine is applied to the field. A one per cent solution of cocaine is injected at the lower part of the scrotum, then the needle is pushed straight down, and a few drops distributed in the globus minor; an incision is made along the anæsthetized line in the scrotum and the point of the knife is advanced into the globus minor, and several stabs or punctures are made. A blunt pointed probe is then pushed along and blind avenues opened up. The wound is then packed with 5 per cent iodoform gauze and the scrotum kept well supported. No sutures are required. THEO. DROZDOWITZ.

Ribbert, H.: Adenoma of the Prostate (Die Adenome der Prostata). *Beitr. z. path. Anat. u. z. allg. Path.*, 1915, lxi, 149.

Ribbert asserts that there is no such thing as true hypertrophy of the prostate in the sense of an enlargement of the whole organ. The enlargement is due to adenomata. He gives 18 illustrations showing the histological structure of normal and enlarged glands in support of his statement. These adenomata originate only in certain parts of the gland. They begin in the posterior wall of the prostatic urethra in the region of the colliculis seminalis. Lendorf has called them accessory glands, but as the adenoma-producing glands extend somewhat into the lateral lobe, they cannot properly be so designated. But the rest of the prostate, the lower, lateral, and middle lobes, and the accessory glands on the upper side of the urethra do not give rise to adenomata. Ribbert suggests the name "inferior prostatic glands" for the part of the glandular structure where these adenomata originate.

Adenomata beginning in the region of the sphincter of the urethra project into the bladder; those in the body of the prostate compress the urethra. As they increase in size they compress the lobes of the prostate into a sort of capsule that remains when the adenoma is shelled out. A. GOSS.

Perrier, C.: Cancer of the Prostate (Contribution à l'etude du cancer de la prostate). *J. d'urol.*, 1915, vi, 457.

Perrier gives the histories of two cases of cancer of the prostate; one an adenocarcinoma, the other a scirrhous carcinoma. Hardness of the gland is given as one of the diagnostic signs by all authors, and in Perrier's second case this was practically the only sign present, for the prostate was not enlarged or changed in form. But in his first case the cancer had softened and broken down, so that the findings on palpation were practically normal. In his second case the presacral lymph-glands were also hardened. These glands are involved earlier than the inguinal glands, involvement of which is generally given as one of the symptoms of cancer of the prostate.

Sometimes multiple metastatic bone tumors are found at autopsy, the origin of which would never be known if the prostate were not examined microscopically, for it may not have presented any signs during life except abnormal hardness. Every prostate that is removed, even if the diagnosis is simple hypertrophy, should be examined for signs of malignancy. One of the author's cases showed metatasis in the corpora cavernosa.

In inoperable cases if catheterization is not tolerated the treatment that gives the most relief is suprapubic cystostomy. A. GOSS.

Lowsley, O. S.: The Human Prostate Gland in Youth. *Med. Rec.*, 1915, lxxxviii, 383.

The author has made a most painstaking examination of upward of 100 prostates taken at autopsy from individuals ranging in age up to twenty years, the article being supplementary to a previous contribution describing the gland of a newborn infant. The five developmental lobes of the prostate are found to remain distinctly demarcated from one another, though without individual capsules, throughout youth and adolesence, the most intimate relation being between the middle and the two lateral lobes; the most distinct demarcation existing between the posterior lobe and the middle and lateral lobes.

About the time of puberty there is a very marked increase in the size of the prostate, the gland increasing in size over 100 per cent, in all dimensions. Thus, in the first half of the first decade the prostate has an average length of 1.2 cm., a width of 1.5 cm., and a height of 0.9 cm., which by the end of the second decade have increased to 3, 3.8, and 2.1 cm. respectively. The growth of the organ is due to an absolute and relative increase in the amount of glandular tissue, the branches of the glands becoming much larger and more numerous. All the ducts except those of the anterior lobe were found to open either on the sides of the verumontanum, or in immediate proximity thereto. The glands of each lobe were always found to be quite distinct from those of its fellows.

S. W. MOORHEAD.

Barnett, C. E.: When Is a Prostatic Fit for Operative Procedure? *Tr. Mississippi Valley M. Ass.*, Lexington, 1915, Oct.

The stand is taken by the author that the general practitioner should learn the cardinal points of danger as to an immediate, non-preparatory operation from the surgeon selected for the prostatectomy, because of the preponderance of prostatectomies done outside of the genito-urinary surgeon's field.

Illustrating the danger from mere cystotomy, without pre-operative preparation, a death is cited, which, in Barnett's opinion, was caused from the effects of the anæsthetic coupled with the absorption of the toxic material from the floor of the bladder which heretofore was not absorbed, because of residual urine causing the venous plexuses to shrink on account of pressure, but when the suprapubic puncture removed the pressure, the now dilated veins fairly drowned the kidneys, whose tubulii were already partly blocked by the acidosis (colloidal swelling), thus prohibiting the excretion of bacterial bodies and inflammatory detritus.

With suggestions regarding the pre-operative preparation, the following contra-indications for prostatectomy are given: when the urine specific gravity is low; when renal function is low; when the urine is markedly acid or alkaline; when scanty urine or polyuria is present; immediately following withdrawal of residual urine; following cystotomy for retention; during gas distention of the bowels.

Regarding anæsthesia, the less fit the patient, the less general anæsthetic used.

The time consumed in the pre-operative preparation should be until the patient's percentage of improvement has reached its topmost degree, no matter if months are consumed.

Bonney, C. W.: The Preparatory Treatment for Prostatectomy. *Interst. M. J.*, 1915, xxii, 909.

When dealing with a case of prostatic hypertrophy there is not only a mechanically obstructed bladder, but also other organs, tissues, and systems which may have been affected by the retrograde changes incident to time or by destructive products of the disease, that require special attention; briefly summarized, the kidneys, the heart, and blood-vessels, the respiratory system, the gastro-intestinal tract and the nervous system.

The drugs which will be found helpful in improving the condition, according to indications present in each case, are: Spartein sulphate, theocin-sodium acetate, diuretin, and potassium acetate with infusion of digitalis, the Niemeyer pill, the nitrites, and Basham's mixture in full dose. As a rule no direct treatment need be employed for mild nervous symptoms, as they diminish or disappear with the establishment of better elimination.

As to urinary antiseptics urotropine in large doses is of great value.

The treatment thus outlined, combined with hygienic measures, will in the course of a few weeks improve the general condition of the patient.

As to local treatment, attacks of acute retention are to be relieved by catheterization, which may be facilitated by a urethral injection of adrenalin chloride, and even a little eucaine, to be followed by an injection of warm, sterile oil just before the catheter is introduced, and the bladder flushed with normal saline solution, weak permanganate of potassium or oxycyanide of mercury solution, or silver nitrate if there be a bad cystitis. Suprapubic cystotomy for drainage is recommended as a preliminary to enucleation of the prostate. It relieves vesical symptoms, improves renal function, and enables patients to gain strength.

In the selection of an anæsthetic, in the opinion of the author, ether by the drop method is the best if it be given by an experienced and skillful anæsthetist. Patients with bad bronchitis and emphysema may constitute an exception. Gas and oxygen are also recommended by men of large experience.

THEO. DROZDOWITZ.

Aybard, L. E.: The Sexual Functions Following Suprapubic Prostatectomy — Freyer's Operation. *Am. J. Urol.*, 1915, xi, 367.

Concerning the causes which may produce varying results following suprapubic prostatectomy the question of advanced age alone is not enough.

Evidently it is due to a difference in the technique of the operation. It is probable that the suppression of ejaculation is simply exterior in the majority of cases.

According to Young's theory ejaculation takes place toward the bladder, and the first urine voided after coitus should be examined for the presence of spermatazoids to make sure of this point.

Freyer affirms in numerous writings that he has never met with weakened sexual power after his operation. Carlier has freely stated that suprapubic prostatectomy has given him disappointment from the standpoint of the preservation of the sexual functions.

Von Frisch says that following perineal prostatectomy patients lose their sexual power, but that this loss appears less certain after suprapubic operation.

Young and Fuller have noted improvement in sexual power after suprapubic prostatectomy. Pauchet also considers that after Freyer's operation the sexual functions are maintained, while Suter of Bale found that they were retained in 9 cases that he operated upon by this method.

Desnos in 1908 stated that the sexual function in his patients, operated upon by this method, had not been weakened.

Loumeau found that 6 of 17 patients operated upon by Freyer's method retained their genital functions. In 7 others these functions had ceased to exist before operation.

Kümmel's statistics recorded by Keyser show that in 101 patients (10 Bottini, 11 perineal and 80

suprapubic), 52 were followed for a sufficient length of time and of these only 3 complained of absence of ejaculations, but they retained their sexual power.

The author records a series of cases, some taken from the literature and 14 personally observed in the service of Professor Legueu. In the 14 cases, the author noted that erection was absent in only one and diminished in another. Erections were normal and the sexual act accomplished in the other cases, but only 7 had external ejaculations.

The author comments that suppression of the sexual appetite does not appear to have occurred except in very old and weak subjects. Erection seems to have been preserved in the majority of cases.

Suppression of ejaculation may be due in many cases to the vasa deferentia being torn away, resulting in narrowed, deformed, or occluded openings. It is probable that in many patients the ejaculation, when not external, takes place into the bladder.

The author concludes that the results of suprapubic prostatectomy are rather favorable from the sexual standpoint, since in his 14 cases erections took place in 13 and external ejaculations occurred in 7 cases, while in Papin's records of 52 case-reports of the perineal operation, 51 had loss of ejaculation and erections occurred in only 12 cases.

H. G. HAMER.

Vinson, J. C.: Suprapubic Prostatectomy. *J., Fla. M. Ass.* 1915, ii, 71.

The author reviews the pathology of the disease, the technique of the operation, and the general management of the patient. He emphasizes the following points:

1. Recognition of prostatic hypertrophy.
2. The necessity of pre-operative care.
3. Value of suprapubic puncture.
4. Efficiency of suprapubic enucleation.

A clear conception of the hypertrophied prostate as being one of adenomatous overgrowth is insisted upon. This overgrowth alters the character of the bladder outlet, the prostatic urethra becoming elevated, contracted, and irregular in outline. All the resultant symptoms are those of urinary obstruction, this being secondary and affecting the bladder, ureters, and kidneys.

He claims that the real excuse for all operations in this condition is based upon the foregoing pathology and symptoms, and the fact, as Squier states, that 50 per cent of cases will die within five years rom the onset of obstruction without catheter life, and catheter life shortens this expectancy about 50 per cent.

The two-stage suprapubic operation is preferred by the author for the reason that a suprapubic puncture and drainage of the bladder is devoid of danger, and can easily be done under local anæsthesia; all other means of effecting suitable bladder drainage have been unsatisfactory in his hands. After the kidneys have regained proper function and the bladder condition clears up, and the general condition of the patient warrants it, an enucleation of the prostate is easily done under general anæsthesia after slightly enlarging the suprapubic opening. He prefers to use nitrous oxide-oxygen anæsthesia in most cases. Ether by the drop method may be risked in a few cases, and chloroform in none.

A half-inch rubber tube is used for drainage, both for the preliminary puncture and following the enucleation. Hot boric acid solution is used t.i.d., and a solution of silver nitrate 1:4000 every other day as a bladder lavage after the preliminary puncture, and salt solution irrigation of the bladder used intermittently after enucleation. The author lays much stress upon the proper protection of the skin and tissues about the tube with sterile vaseline.

Within three or four days following enucleation the patient is encouraged to pass urine; the drainage tube is removed in from three to six days, and the opening usually closes in from fourteen to twenty-one days. Fistula has never resulted in Vinson's experience. Urinary antiseptics are always used, and recovery is complete with the best functional results. Patients are always asked to return in three months for complete urinary and cystoscopic examination.

JOHN S. HELMS.

MISCELLANEOUS

Cumston, G. C.: Sardou's Test for Blood in the Urine. *Am. J. Urol.*, 1915, xi, 364.

The detection of blood in the urine by phenolphthalein has many practical applications in cases of mild hæmaturia or hæmaglobinuria.

Whenever the test for albumin in the urine is necessary, if it is in small amount, it is essential to look for the presence of blood, which otherwise might give rise to erroneous conclusions as to the amount of albumin.

In these instances microscopical examination is insufficient because certain urines are directly toxic for, and have an osmotic action on, the red blood corpuscles, so that only the transudated hæmaglobin can be recognized.

The slight hæmaturia in urinary lithiasis or nephroptosis incident to physical exercise, likewise early tuberculosis and renal cancer, may be detected by the phenolphthalein test.

The technique of the test is as follows:

1. Meyer's phenolphthalein reagent, prepared as follows: phenolphthalein 2 gr.; potassium hydrox 20 gr. :dissolved in distilled water 100 gr.; to which is added impalpable powdered zinc 10 gr. This is brought to the boiling point, when the mixture will be red, but progressively becomes decolorized from the reduction of the phenolphthalein into phenolphalin.

2. Acetic alcohol: acid acetic crystal 2 ccm., alcohol, 90 per cent, 98 ccm.

3. Peroxide of hydrogen at 12 volumes. Three cubic centimeters of non-filtered urine, just made homogenous by shaking, are poured into a test-tube; then three cubic centimeters of acetic alcohol are added. The tube is then shaken and one cubic centimeter of Meyer's reagent is added and after again shaking, three drops of the oxygen water are added.

If the urine contains blood a more or less intense rose color should appear, according to the amount of blood contents present. The reaction is complete in from a few sconds to three minutes and retains its intensity for some time.

The test is quite as reliable as microscopic examination and has advantage over the latter, as according to the degree of molecular concentration of the urine, due principally to chlorides, the globules often undergo hæmolysis and can not be seen microscopically: also in hæmaglobinuria the microscope is useless.

Sardou has been able to obtain a slight reaction at the end of five minutes in a urine diluted to 1:5,000,000 and distinct reactions in urine diluted to 1:1,000,000.

A more distinct reaction is obtained by filtering the mixture of urine, acetic alcohol, and Meyer's reagent and adding 2 drops of oxygen water to 4 ccm. of the filtrate.

Sardou says that no other body in the urine can give the reaction, such as albumin, glucose, urobilin, bile pigment, indican, phosphates, acetone, or uric acid.

The same also applies to drugs such as antipyrine, the iodides and bromides, salicylic and carbolic acids.

Pus usually does not cause the reaction.

The author has found the test of value and very reliable. H. G. HAMER.

Michelli, E.: Value of Degeneration of Leucocytes for the Quick Diagnosis of Genito-Urinary Tuberculosis (Sur la valeur de la dégénérescence leucocytaire pour le diagnostic rapide de la tuberculose uro-génitale). *J. d'urol.*, 1915, vi, 409.

Michelli discusses the difficulty of making a diagnosis of tuberculosis of the genito-urinary tract by the ordinary methods of examining the urine. In a considerable percentage of cases the bacilli cannot be found in the urine, and even when found, there is great difficulty in making a differential diagnosis between tubercle bacilli and other forms, especially the smegma bacillus.

Colombino has described a sign which he considers of great value in making a rapid diagnosis. It consists of a degeneration of the leucocytes in a fresh specimen of urine. A drop of the sediment is placed under the microscope and examined without staining. The form of the leucocytes is very variable; they may be elongated, polyhedral, or crenated. The contour is irregular; sometimes there are little globules of protoplasm at the periphery that seem about to become detached from the leucocyte, and it looks as though the envelope of the cell had bursted. The protoplasm around the nuclei is reduced considerably, as if eaten away; indeed, nuclei almost free of any surrounding protoplasm may be found. There are many vacuoles in the protoplasm of some nuclei. In addition to these changes in the leucocytes, red cells can be demonstrated microscopically in tubercular cases. Red cells are almost constant in tubercular urine, even when the patient is absolutely at rest.

Michelli believes that this sign is of great value in the diagnosis of genito-urinary tuberculosis, and describes two cases of his own in which he was enabled to make a diagnosis by means of it, when other methods of diagnosis had failed. Some authors have claimed that there is degeneration of the leucocytes in gonorrhœal cystitis; there may be some slight change in the contour of the leucocyte in such cases, but there are never the pronounced and characteristic changes described by Colombino in tuberculosis. The value of the method is increased by its simplicity. Colombino emphasizes the importance of making the examination immediately after the urine is passed, to avoid subjecting the leucocytes to any traumatism. If it is allowed to stand, changes take place in the form of the cells. A. Goss.

Williamson, T. V., and Budd, S. W.: The Complement-Deviation Test as a Guide in Infections of the Urethra, Prostate, and Vesicle. *South. M. J.*, 1915, viii, 781.

The authors state that the complement-deviation test is of great value in treating gonococcus infection of the urinary and sexual organs. The test becomes positive about the third to sixth week of the disease. It is frequently positive after all other methods to detect the presence of gonococci have failed. The test remains positive a month or two after a clinical cure. This period roughly corresponds to the time needed to develop antibodies in the blood at the beginning of the disease.

The chief value of this test is in the chronic cases in which the existence of the gonococcus is difficult to establish by any other method, and by it the authors state they are enabled to determine whether a man is still infectious or not even though he may have some slight discharge which the complement-deviation test shows is not due to gonococci.

The test also has a medicolegal value, particularly to determine who acquired gonorrhœa first, as between a husband and wife. V. D. LESPINASSE.

Ashcraft, L. T.: Report on a Series of Nephrectomies. *N. Eng. M. Gaz.*, 1915, l, 445.

The author gives his personal experience in a series of nephrectomies, all but two of which were performed on account of renal tuberculosis. He strongly emphasizes the necessity for nephrectomy in that disease.

In connection with the technique of operation he states that the majority of these kidneys were

removed through the curved lumbar incision, without resection of the last rib. In treating the ureter he follows Mayo's suggestion of cauterizing the stump with a 5 per cent solution of carbolic acid. In advanced cases, however, when the ureter must be removed, he advises removing the kidney through an incision made as if for exposure of the iliac artery, as suggested by Kelly and later popularized by Lilienthal.

He considers Cathelin's method of dealing with the stump, to be ideal. It consists in drawing the kidney forward as far as possible, displacing it from its niche and wrapping it with a gauze compress. Next, the various elements of the stump are separated with the fingers, and held with the aid of another gauze pad. Each of the vessels is then taken up with an artery clamp, and tied separately, often without the patient's losing a single drop of blood. The best material for the ligature is catgut, provided that a good quality of No. 4 gut be employed. After the vessels have been tied separately, and the kidney has been removed, a general ligature is applied, half a centimeter beneath all the others, and is tied with a double sailors' knot. Finally, in spite of the great security of this method, another general ligature is applied, one centimeter below the other, No. 4 catgut being used. In this manner, one obtains a very safe ligation of the stump. Sometimes forcipressure is applied by means of a clamp having an elastic blade. This is retained in position for two or three days. The wound is packed with iodoform gauze, usually at the upper angle.

In speaking of the after-treatment, he says that for persistent cystitis, the bladder must be irrigated daily with 1:50,000 bichloride of mercury solution, commencing with 30 to 60 ccm. and at each subsequent treatment increasing the amount of fluid and the strength of the solution. Sometimes a six per cent carbolic-acid solution or a saturated solution of boracic acid is employed. In all circumstances, after each irrigation, there should be injected 10 ccm. of a twenty per cent solution of carbonate of guaiacol, and one per cent iodoform, in olive oil. This seems to exert a remarkably beneficial effect on the bladder. By means of these methods the capacity of the bladder is increased. The urine becomes quite free from pus, blood, and débris; and the interval between the acts of micturition is prolonged from two and a half to three hours. This is true, not only of those who have been nephrectomized, but also of those in whom the tuberculous process is too far advanced for operative interference. The procedure in the latter case is merely palliative. In the former, however, it serves to heal any local lesion that may arise in the bladder. W. E. LOWER.

Williams, B. G. R.: The Formation of Urinary Calculi. *N. Y. M. J.*, 1915, cii, 609.

The author enumerates and discusses the chief theories of urinary lithiasis, a phenomenon secondary to alterations in the chemical composition and the urine. They are:

1. The theory of overplus salt content.
2. The theory of organic nucleus.
3. The theory of fermentation.

The experimental and clinical data of the author is to show that lithiasis is usually or always secondary to processes of fermentation, and, likely that the ferments are more elaborated by micro-organisms than by body cells.

In preluding his records of experiments the author states that the appearance in the urine of known body ferments (pepsin, lipase) does not cause deposition of crystals, nor do such ferments, when purposely added in small amounts, have any such action.

The author points out that in his clinical oxaluria hexamethylenamine gave the most beneficial results.

Antiseptics, as boric acid and camphor, were used in the author's experiments for sterilization. In all cases the results of these experiments tallied; namely, precipitation was thwarted or retarded by antiseptics.

By these experiments and observations the author feels justified in blaming fermentations, or processes akin, for the deposits of salts (especially oxalates) in the urinary passages. And these active bodies may be micro-organisms or their enzymes rather than true body ferments and concludes that deposits of certain salts in the urinary tract may be influenced indirectly by (1) overplus elimination; (2) concentration of urine; (3) presence of organic matter, etc.

He considers that deposits *in vivo* are directly accounted for by the action of certain ferments, doubtless of microbic origin. He also suggests that we might be dealing with ultramicroscopic ferment producers. H. W. PLAGGEMEYER.

SURGERY OF THE EYE AND EAR

EYE

Stieren, E.: Congenital Coralliform Cataract. *Penn. M. J.*, 1915, xviii, 870.

Stieren reports a case of bilateral congenital cataract of both lenses, of the type known as fusiform or coralliform, with radiating opacities resembling the branched twigs of a piece of white coral, between which the lens was clear, as was also the equatorial region. The affection was probably hereditary, as the father and grandfather both had poor vision. G. D. THEOBALD.

Stieren, E.: A Case of Ectropion. *Penn. M. J.*, 1915, xviii, 870.

Complete ectropion, following an extensive burn of the entire right side of the face, resulted from cicatrization which involved the entire orbital region. Skin-grafting was resorted to, because no healthy skin remained any place near the eye that could be utilized for a flap. G. D. THEOBALD.

Weisser, E. A.: Case of Congenital Malformation of the Cornea. *Penn. M. J.*, 1915, xviii, 870.

The author reports a case presenting a cornea almost completely opaque, in a slightly microphthalmic eye. The opacity was almost chalky white, but at a spot or two there was a partial clear cornea through which the iris could be seen. There was no staphyloma or other complications. G. D. THEOBALD.

EAR

Lang, J.: Acute Suppurative Inflammation of the Middle Ear After the Removal of Nasopharyngeal Tumors with the Galvanocautery Loop (Über akute eitrige Mittelohrentzündung nach der Entfernung der Nasenrachentumoren mittelst der galvanokaustischen Sclinge). *Monatschr. f. Ohrenh.*, 1915, xlix, 289.

In 56 cases of nasopharyngeal tumors which were removed by means of the galvanocautery loop, acute inflammation of the middle ear was observed in 14; and in 5 of these it occurred twice in succession. In one of these cases the middle-ear inflammation and acute mastoiditis appeared without any demonstrable cause. This is not surprising, for in other affections of the nasopharynx, such as adenoid vegetations, the catarrhal or inflammatory condition of the pharynx may be transmitted through the eustachian tube into the middle ear.

In one case the acute middle-ear inflammation was the result of nasal irrigation. This leaves 12 cases in which the inflammation of the middle ear was caused by the removal of the tumor with the galvanocautery loop. This is easy to explain. The catarrhal and inflamed condition of the mucous membrane of the pharynx caused by the tumor is greatly increased by the caustic action of the galvanocautery, so that it is much easier for it to be transmitted to the surrounding tissues. This inflammation is in the immediate neighborhood of the pharyngeal opening of the eustachian tube, and can very easily pass over its mucous membrane into the middle ear. The intensity of the inflammation is shown by the fact that the mastoid process is also often involved, and that even pyæmia has been produced, which, however, was cured by the injection of electrargol.

After removal of tumors from the nose and nasopharynx with the galvanocautery loop, acute inflammations of the middle ear appear in about 25 per cent of the cases, but nevertheless the operation should not be given up, for it is the simplest and least dangerous of all the operations for nasopharyngeal tumors. Excellent results have been obtained with it, and the inflammation of the middle ear is a much lesser evil than the dangers attendant upon the other methods of operation. A. Goss.

Bledsoe, R. W.: Acute Purulent Otitis Media Complicated by Mastoiditis and Temporosphenoidal Abscess. *South M. J.*, 1915, viii, 823.

The author reports the case of a 6-year-old boy who developed a large swelling behind his left ear, for which a Wilde incision was made. The patient did very well for eight days when a right hemiplegia developed, and the patient lapsed into a semicomatose condition. A simple mastoid operation was performed, after which the patient regained the use of the right side; mentality was normal and the patient seemed on the road to recovery. This improvement lasted nine days when he began to relapse into his former semicomatose condition. At this time the temporosphenoidal lobe was explored and an abscess found and evacuated. From this time on the patient made an uneventful recovery.

This case is of interest chiefly from the fact that a simple mastoid operation caused for nine days a complete disappearance of the symptoms of pressure on the brain. OTTO M. ROTT.

Shambaugh, G. E.: Clinical Problems in Connection with Some of the Complications of Acute Otitis Media. *Illinois M. J.*, 1915, xxviii, 161.

While the author refers to the well-known symptoms of a typical case of mastoiditis, before and after

abscess formation, and of the complication of lateral sinus thrombosis, the most valuable feature of the article is the stress laid upon the fact that it is not always the typical textbook case which we encounter, but such instances as when an intracranial complication develops without any distinct evidence of softening in the mastoid and where even a sinus thrombosis develops where the evidence of an otitis media was limited to a slight congestion of the drum membrane.

Regarding mastoid symptoms, they are to be regarded with much greater suspicion if they develop after the ear has been freely discharging than when these same symptoms develop before the drum membrane has been opened.

The relative merits of transillumination and röntgenography of the mastoid are discussed, the latter being considered of more importance as a diagnostic measure.

Another important feature of mastoiditis upon which the author lays stress is the presence of urgent symptoms in the absence of abscess formation and the absence of these same symptoms in cases where an extensive abscess cavity has developed in the mastoid process.

The persistence of trouble after the mastoid has been operated on and the management of sinus thrombosis with and without breaking down of the thrombus, are discussed. OTTO M. ROTT.

Woulfe, C. T.: The After-Treatment of the Mastoid Wound. *J. Ophth. & Oto-Laryngol.*, 1915, ix, 285.

This article deals with the after-treatment of the simple mastoid operation. The author lays stress upon the importance of the after-treatment, stating that the operation is only one step in the proper care of the patient.

Gauze packing is preferred to the blood-clot method because of the uncertainty of the latter. After suturing the upper angle of the wound, gauze is inserted quite firmly and a bandage applied. A strip of gauze is also inserted into the meatus to the drum. On the fourth or fifth day dressings are changed for the first time, providing no complications demand an earlier inspection of the wound. The stitch is removed and plain gauze inserted but with only moderate pressure, and care is taken to insert gauze under the border of the skin wound so as to prevent falling in of these edges. The gauze is removed from the meatus and if moist another piece is inserted. The dressings are changed every other day until the cavity is fairly filled with granulations, when the gauze is discarded in favor of boric acid powder.

A cause of non-healing is necrotic bone left, which needs to be curetted or which demands a secondary operation. Another factor is the general condition of the patient, which requires building up.

OTTO M. ROTT.

SURGERY OF THE NOSE, THROAT, AND MOUTH

NOSE

Sullivan, J. J.: The Examination of 106 Cases of Nasal Accessory Sinusitis, Showing the Value of Routine Examination and Certain Internasal Operative Proceedings, *Laryngoscope*, 1915, xxv, 667.

The following routine is practiced by the author:

1. The nose is examined before and after contraction with cocaine and adrenalin.
2. The nose is syringed with normal salt solution, and the fluid collected in a black pus basin.
3. Transillumination.
4. X-ray and comparison with the transillumination markings of the sinus.
5. Positions: (*a*) Erect, head down, side examined uppermost; (*b*) head upward, erect, and erect slightly backward for the frontal sinus; (*c*) head forward on the chest for the sphenoid (anterior ethmoids sometimes give pus in this position); (*d*) head skyward in the prone position for posterior ethmoids.
6. Puncture and irrigation of the maxillary sinus under the inferior concha. After puncture a probe is passed through the opening and search made for thickened membrane, etc.
7. The middle turbinate is infracted and the ethmoid and frontal sinuses probed.
8. If necessary to examine the sphenoid and posterior ethmoids more closely because of urgent symptoms, the middle turbinate is removed.

As regards operations the author has had very satisfactory results with the Ballenger operation for the complete ethmoid exenteration and the Ballenger-Canfield operation on the antrum. OTTO M. ROTT.

MOUTH

Solenberger, A. R.: Subperiosteal Abscess of the Maxillary Sinus. *Colo. Med.*, 1915, xii, 269.

The author calls attention to the fact that in this particular affection the dentist must stand sponsor for the prophylactic treatment, and questions whether rhinologists have been sufficiently insistent upon the dentist's responsibility.

The symptoms are usually inconstant, the infection progressing slowly and often painlessly. The antral floor is often thick, often very thin with the apices of roots of teeth penetrating the floor. On the nasal side there is usually little change.

Periodical discharge of pus from the sac is as a rule preceded by pain usually of a facial neuralgic type which ceases after the evacuation. These patients are increasingly subject to infectious inflammations of the respiratory tract; viz., chronic rhinitis, bronchitis, pulmonary cellulitis, all of which disappear after cure of the abscess. Aspiration of the sinus is usually negative and the X-ray is helpful only when the abscess has become thickened and distended.

Dental history is often not reliable and the removal of a tooth, unless it can be demonstrated to be the offending member, is bad practice, and in this extremity the author advocates an examination through a sufficiently large opening in the anterior wall. He was led to adopt this procedure by his experience in operating by the Luc-Caldwell method, when he frequently found a mass of granulation tissue in the floor of the antrum which often led to an abscess about the apex of a tooth. This condition he asserts is the cause of failure in many cases which had been done in an otherwise thorough manner. H. A. POTTS.

Sticker, A.: Fifteen Cases of Cancer of the Mouth Successfully Treated with Radium (15 Fälle von Mundhöhlenkrebs mit Radium günstig behandelt). *Berl. klin. Wchnschr.*, 1915, lii, 1040.

Sticker describes 15 cases which he has successfully treated with radium, 3 of cancer of the tongue, 7 of the lower jaw, and 5 of the upper jaw. He gives the details of the case histories and describes the special holders which were made to hold the radium in place during the night. The radium was applied 12 hours each night, varying from three up to as many as fourteen nights. Some of the cases had not been operated upon, some were recurrences Two of the tongue cases showed deep ulcers which healed under the treatment. In the third case a tumor the size of a cherry disappeared, and the pain, which had been intense, stopped. Two of the lower jaw cases are still under treatment, but show great improvement; one healed, leaving a fistula, the others all disappeared completely, not even leaving any scar tissue. One of these recoveries was seven months ago and there are no signs of recurrence. One of the upper jaw cases is still under treatment, the others have recovered, and two of the recoveries have persisted for seven months.

Sticker points out the superiority of radium treatment over surgery, especially in those cancers of the mouth, where operation is so disfiguring. The radium treatment leaves no deformity whatever. Moreover, he holds that in cancer general surgery tends to favor recurrence, that is, after removal of a uterine cancer there is apt to be recurrence in the vagina, whereas when the uterine tumor is left intact there is no involvement of the vagina. Radium treatment, on the other hand, tends to produce immunity. The destroyed cancer-cells are taken up in the body fluids and produce antibodies which immunize the body against cancer. A. GOSS.

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